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MEMORANDUM:

TO: RECIPIENTS OF MONTANA DESIGN MANAGEMENT PROJECT PROGRESS REPORTS

FROM: LANCE STAPLETON, Roy Jorgensen Associates, Inc.

SUBJECT: PROGRESS FILE NOTEBOOKS AND PROGRESS REPORTS

Enclosed you will find the Progress File Notebooks and the Progress Report for the month of October.

To aid in the orderly accumulation of project information, a notebook divider system has been developed based on the work phases of the contract -- Phase IV covers the development of a final report which will be issued under separate cover.

Please separate and file the previously submitted information according to the following:

1. File the Progress Reports dated October 1 and September 1, 1970 behind the divider heading "Progress Report".

2. File the attachments included with the September Progress Reports as follows:

   - File the project schedules behind the divider heading "Summary File".

   - File the remainder of the attachments -- Current Status Review and Manpower Inventory -- behind the divider heading "Phase I".

Future progress reports will indicate the appropriate filing order for any attachments.

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PROGRESS REPORT

MONTANA DESIGN MANAGEMENT PROJECT

PROGRESS REPORT

December 1, 1971

Work underway during November was directed toward Phases III and IV of the project.

PHASE III

Accomplishments in Phase III include: (1) continuation of the development of the Design Management Manual, (2) continuation of the development of the Design Manual, and (3) continuation of the testing program for the scheduling and evaluation system.

Design Management Manual

Development of the Design Management Manual continues. As a result of the Department review and approval of the manual in November, minor changes are being made in content prior to printing. A camera-ready copy will be completed in December.

Design Manual

The top-level management in the Department reviewed and approved the Design Manual in November. The camera-ready copy will be completed in December.

Scheduling and Evaluation

Programming in accordance with the requirements of the scheduling system continues. Programming is now approximately 60 percent complete.

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PHASE IV

Final Report

The writing of the final report documenting the findings and conclusions of the project continues. Distribution of the review copies of the report is scheduled for December.

MONTANA DESIGN MANAGEMENT PROJECT

PROGRESS REPORT

November 1, 1971

Work underway during October was directed toward Phases III and IV of the project.

A time extension and adjustment on the limitation on consultant payments was granted by the Department. These adjustments were made necessary by unavoidable problems developing throughout the project and additional work requested by the Department. The project is now scheduled for completion on December 31, 1971.

PHASE III

Accomplishment in Phase III include: (1) continuation of the development of the Design Management Manual, (2) continuation of the development of the Design Manual, and (3) continuation of the testing program for the scheduling and evaluation system.

Design Management Manual

Development of the Design Management Manual continues. A draft copy of the manual is scheduled to be delivered to the Department for their review and approval in November. A camera-ready copy will be completed in December.

Design Manual

Work on the Design Manual continues. A draft copy of the manual has been completed and approved by the Design Manual Committee. The complete draft copy of the manual is scheduled to be delivered to top-level management in the Department for their review and approval in November. The camera-ready copy will be completed in December.

Scheduling and Evaluation

Approval was obtained in September to initiate programming of the scheduling and evaluation system. Programming of the system is now approximately 50 percent complete.

PHASE IV

Final Report

The writing of the final report documenting the findings and conclusions of the project continues. Distribution of the review copies of the report is scheduled for completion in December.

Roy Jorgensen Associates, Inc.

MONTANA DESIGN MANAGEMENT PROJECT
PROGRESS REPORT

October 1, 1971

Work underway during September was directed toward Phases III and IV of the project. All project elements are on or ahead of schedule.

PHASE III

Accomplishments in Phase III include: (1) continuation of the development of the Design Management Manual, and (2) continuation of the development of the Design Manual.

Design Management Manual

Development of the Design Management Manual continues. The first draft copy of the manual has been completed and segments have been delivered to the Department for their review. Work on this phase is anticipated to be completed ahead of schedule.

Design Manual

Work on the Design Manual continues. Final drafts of eight chapters have been completed. Drafting has been completed on four chapters. Draft copies of four chapters will be reviewed with the committee during October. Data will be gathered and the remaining three chapters will be written during October.

Design Manual (continued)

Initial distributions of partial manuals will be accomplished in October pending receipt of the paper for printing.

PHASE IV

Final Report

Work has been initiated in the writing of the final report documenting the findings and conclusion of the project. Distribution of the review copies of the report is anticipated for the middle of November.

MONTANA DESIGN MANAGEMENT PROJECT
PROGRESS REPORT

September 1, 1971

Work underway during August was directed toward Phases II and III of the project. All project elements are on or ahead of schedule.

PHASE II

Accomplishments in Phase II include: (1) completion of drafting work of the sequencing of activities, (2) completion of development work on standards, (3) continuation of the testing period for the standard drawings recommendations, and (4) completion of the development of a scheduling and evaluation system.

Sequence of Activities

Development work and final drafting of the workflow is complete. The diagram of the workflow will be included in the Design Management Manual.

Standards

Initial planning values have been established for each of the 61 activities in the summary workflow. These values were established by a committee of road design personnel utilizing information gathered during the project and based on their experience. Planning values were established for a base project -- primary, two-lane project, five miles long, located in a rural non-irrigated

culture type and in a flat and rolling terrain. These standard values were then adjusted to reflect the changing conditions according to : (1) system type, (2) project length, (3) culture, and (4) terrain. In addition, the percentage time requirement for each of the five classifications -- Technician I, II and III, Senior Technician, and Project Supervisor was determined for each activity.

Work on this phase is completed and will be documented in the final report.

Standard Drawings

Initial drafting work on standard drawings is complete on schedule. The completed standard drawings will now be checked in-depth for adequacy and accuracy. Implementation of the standard drawings should be possible as per the anticipated date of January 1, 1972.

Scheduling and Evaluation

The development of a scheduling and evaluation system is complete. During the course of this phase, the following items were developed: (1) a summary network, (2) a flow diagram of the system, and (3) example input and output reports. The scheduling and evaluation system will be documented in the Design Management Manual and the final report.

PHASE III

Accomplishments in Phase III include: (1) completion of the training needs analysis and development of a training plan, (2) continuation of the development of the Design Management Manual, and (3) continuation of the development of the Design Manual.

Training Plan

The training needs analysis for road design has been completed. The needs of the personnel have been estimated relative to 26 common knowledge,

skill and ability, and major activity statements. These needs were determined by the administration of written and performance tests to a random sample of road design personnel.

A training plan for the Department has been developed which documents the training needs of the road design personnel and outlines the considerations which should be given to future actions.

A report which indicates the objectives, data, conclusions and training plan is attached to this progress report.

Design Management Manual

Development of a draft copy of the Design Management Manual continues. Work on this phase is anticipated to be completed ahead of schedule.

Design Manual

Work on the Design Manual continues. Final drafts of three chapters have been completed. The Committee has reviewed an additional five chapters which should be ready for printing next month. Data has been gathered which will allow the writing of additional chapters. These chapters will be presented to the Committee next month.

Initial distributions of partial manuals will be accomplished late in September or early October. Work on this phase is on schedule.

MONTANA DESIGN MANAGEMENT PROJECT
PROGRESS REPORT
August 1, 1971

Work underway during July was directed toward Phases II and III of the project. All project elements are on or ahead of schedule with the exception of the development of standards.

PHASE II

Accomplishments in Phase II include: (1) continuation of drafting work of the sequencing of activities, (2) continuation of development work for productivity standards, (3) continuation of the testing period for the standard drawings recommendations, and (4) continuation of the development of a scheduling and evaluation system.

Sequence of Activities

Development work on the proposed work flow is complete. Final drafting of the work flow is approximately 80 percent complete.

Productivity Standards

A total of 240 work activities have been defined in the work flow. Initial meetings have been conducted to establish planning values for each of the activities. Work on this element is expected to be completed in August.

Standard Drawings

Drafting work on standard drawings is approximately 80 percent complete.

Work on this phase is considered to be on schedule and should be completed in August.

Scheduling and Evaluation

Work on this phase of the project continues. Development of the concepts, workflow and forms have been completed for the scheduling system. A detailed network incorporating all activities defined in the workflow and a summary network have been developed for the scheduling system.

Efforts are being directed toward developing an evaluation system for Road Design which is compatible with other functions in a Highway Department.

PHASE III

Accomplishments in Phase III include: (1) continuation of development work for performing a training needs survey, (2) continuation of the development of the Design Management Manual, and (3) continuation of the development of the Design Manual.

Training Needs

Work on the development of a training needs survey continues. A total of 26 common knowledge, skill and ability and major activity statements have been defined. Test questions have been developed for each of the 26 statements.

Testing of a sample of the design personnel will be conducted in August. Based on this test a training plan will be developed which will identify training deficiencies and the magnitude of the training need.

Work on this element is considered to be on schedule.

Design Management Manual

Development of a draft copy of the Design Management Manual continues.

Work on this element is anticipated to be completed ahead of schedule.

Design Manual

Work on the Design Manual continues. Final drafts of two chapters have been completed. Additional chapters have been completed in draft form and are ready for committee review. A committee meeting to review the draft chapters is scheduled for August.

Work on this element is on schedule.

MONTANA DESIGN MANAGEMENT PROJECT
PROGRESS REPORT
July 1, 1971

Work underway during June was directed toward Phases II and III of the project. All project elements are on or ahead of schedule with the exception of the development of productivity standards.

PHASE II

Accomplishments in Phase II include: (1) completion of development work in the sequencing of activities, (2) continuation of development work for productivity standards, (3) completion of a road design check list, (4) continuation of the testing period for the standard drawings recommendations, and (5) continuation of the development of a scheduling and controlling system.

Sequence of Activities

Development work on the proposed work flow is complete. The work flow has been turned over to the Department for final drafting.

Work on this phase has been completed on schedule.

Productivity Standards

Work on productivity standards is being delayed pending a determination of the correct activity statements. This determination will be made based on the requirements of the scheduling and controlling system.

Work on this phase is considered to be behind schedule.

Road Design Check List

A check list for determining adequacy and accuracy of a set of plans has been prepared. The check list has been recommended to the Design Management Committee and has been approved. Attached to this report is a copy of this check list.

The work is complete.

Standard Drawings

Drafting work on standard drawings is approximately 75 percent complete.

Work on this phase is considered to be on schedule and should be completed in August.

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MONTANA DIVISION

Scheduling and Controlling

Work on this phase of the project continues. Work is being directed toward developing an integral scheduling and controlling system which implement the concepts developed during the design stage of the project.

Work on this phase is considered to be on schedule.

PHASE III

Accomplishments in Phase III include: (1) completion of development work on a Preconstruction organization and position guides, (2) continuation of development work for performing a training needs survey, (3) completion of the proposed personnel classification and salary plan and terms of employment analysis, (4) continuation of the Development of the Design Management Manual, and (5) continuation of the development of the Design Manual.

Organization

The development work on a Preconstruction organization is complete.

Please refer to the attached information relative to the recommended organization and position guides. This information will be included in the Design Management Manual.

This phase of the project is complete on schedule.

Training Needs

Work on the development of a training needs survey continues. Work is being directed toward testing a random sample of Preconstruction employees to ascertain training needs. Questions will be developed to test work activities as well as specific knowledge, skills and ability requirements.

Work on this phase is ahead of schedule, however, time will be required to develop valid test questions. Work is anticipated to be completed on schedule.

Classification and Salary Plan

Work on the classification and salary plan is complete. The Engineering and Technician plan was presented to the Montana Highway Commission during June. The Commission studied the concepts and objectives of the plans and will consider implementation in January 1972.

Please find attached to this report the classification and salary plan and the classification statements. Also included with this report are the summaries of the analyses conducted on the conditions of employment data collected during the salary survey.

Work on this phase of the project is complete on schedule.

Design Management Manual

Development of a draft copy of the Design Management Manual continues. The organization chart and position guides will be included in the Design Management Manual.

Work on this phase of the project is ahead of schedule.

Design Manual

Work on the Design Manual continues. Three chapters were reviewed by the Design Manual Committee during June. Data were gathered for additional chapters which will be reviewed during July.

Work on this phase of the project is ahead of schedule.

MONTANA DESIGN MANAGEMENT PROJECT

PROGRESS REPORT

June 1, 1971

Work underway during May was directed toward Phases II and III of the project. All project elements are on or ahead of schedule with the exception of the development of productivity standards.

PHASE II

Accomplishments in Phase II include: (1) continuation of the testing program for plan standardization work, (2) continuation of development work in the sequencing of activities, (3) continuation of development work for productivity standards, (4) development of a preliminary road design check list, (5) continuation of the testing period for the standard drawings recommendations, and (6) continuation of the development of a scheduling and controlling system.

Plan Standardization Testing

Representatives of the District Engineers reviewed the proposed model plans. Their comments and recommendations made during the review are receiving serious consideration.

A final review of the model plans will be held on June 2 by the Design Management Committee. Final Department approval of the format and content will be recommended in late June or July.

Sequencing of Activities

Development work on the proposed workflow continues. Preliminary workflows are expected to be completed during June or early July.

Work is considered to be on schedule.

Productivity Standards.

The analysis of historical data related to manhours and costs required to produce a set of plans is complete. The selective reporting system has been terminated and the information is being compiled. Method studies of actual work situations have been conducted for approximately four weeks. These data have been compiled and are being analyzed.

Productivity standards by work activity are expected to be recommended to the Design Management Committee during June or early July. Implementation and testing of the standards will follow upon implementation of the reporting system.

Work on this phase is considered to be behind schedule due to a delay in receiving computer printouts. However, the significance of the delay is not great due to the timing of the implementation and testing of the reporting system.

Road Design Check List

A preliminary check list for determining adequacy and accuracy of a set of plans has been prepared. The check list will be recommended to the Design Management Committee for their consideration during June.

Standard Drawings

Drafting work on standard drawings is approximately 60 percent complete. This drafting work is scheduled to be complete in August.

A meeting of the Standard Drawings Committee was held to review progress and work accomplished on the standard drawings to date. Work was considered to be adequate and satisfactory.

Work on this phase is considered to be on schedule.

Scheduling and Controlling

The concepts for an integrated scheduling and controlling system have been developed. Please refer to the attachments for more complete information with regard to the recommended system and a work plan for implementation and testing.

Work on this phase is considered to be ahead of schedule.

PHASE III

Accomplishments in Phase III include: (1) completion of development work on a Preconstruction organization, (2) continuation of development work for performing a training needs survey, (3) testing of the proposed personnel classification and salary plan, (4) completion of the terms of employment analysis, (5) continuation of the development of the Design Management Manual, and (6) continuation of the development of the Design Manual.

Organization

The first recommendations relative to the approved Preconstruction organization have been made to the Department. These recommendations relate to the following Sections within Preconstruction: (1) Surfacing, (2) Public Hearings, and (3) Field Design. Other recommendations will be made when their implementation will be augmented and supported by the develooment of specific statements of Policy and Procedure.

This phase of the project is considered to be on schedule.

Training Needs

Work on the development of the concepts of a training needs survey continues. The scope of this phase of the project has been expanded. The staff is now contemplating testing a random sample of the Preconstruction employees engaged in road design to determine training needs by work activity as well as specific knowledge, skills and ability requirements.

This phase of the project is being accelerated to allow the accomplishment of this work.

Classification and Salary Plan

The proposed Engineering and Technician classification and salary plan was tested in the Preconstruction Division. Engineering and technician personnel were evaluated under the preliminary plan. The objectives of the test evaluation session were as follows:

1. To test the proposed personnel classification system.
2. To assign proposed personnel classification and rates of pay to each employee evaluated.
3. To evaluate the findings and develop implementation cost estimates.

The evaluation of the findings and adjustments in the classification and salary plan continues. It is anticipated that recommendations will be made to the Department as a result of the testing period in July.

This phase of the project is considered to be on schedule.

Terms of Employment

Current terms of employment have been compared to the prevailing terms of employment as documented by the salary survey. Statistics and restrictions have been documented related to existing practices and statutory requirements.

Recommendations to the Department have been delayed pending further developments in the Manpower Management project.

This phase of the project is complete as per schedule.

Design Management Manual

Development of a draft copy of the Design Management Manual continues. A testing program was completed to ascertain the most effective writing style for the manual. Based on the results of this test, a draft of the introduction to the manual and the first section -- Organization -- has been developed.

This phase of the project is considered to be ahead of schedule.

Design Manual

A meeting of the Design Manual Subcommittee was held to: (1) review the objectives of the manual, (2) review a mock-up of the manual illustrating the intended format, (3) review the subject matter table of contents, and (4) gather data for the first several chapters of the manual.

SCHEDULING AND CONTROLLING

During the course of the Design Management project the concepts and workflow for an integrated scheduling and controlling system have been developed. The integrated system has the following characteristics:

1. Scheduling system data and networks generated by a computer.

2. Establishment of time objectives including the following:

   +. Target dates for major phases of a project, and

   +. Interim target dates for milestones between major phases.

3. Projections of manpower requirements per project based on:

   +. Specific work descriptions - activities,

   +. Productivity standards for each activity,

   +. Characteristics of each project,

   +. Number of units of work to be accomplished for each project, and

   +. Manpower requirements by employee classification for each activity.

4. Projections of manpower requirements for all projects for specific time periods based on:

   +. Manpower requirements for individual projects by time period, and

   +. Allowances for training, employee leave and other overhead items.

5. System of control allowing the monitoring of project progress based on:

   +. Required units of work versus the actual accomplishment as of a specific time, and

   +. Computer accessibility to stored data.

6. Reporting system with the following major characteristics:

   +. Reports developed for top level management utilizing the exception reporting principle, and

   +. Reports developed in varying degrees of detail for other levels of management.

The illustration of the workflow developed by organization level and the computer installation is shown in Figure 1.

There is need for the development of a plan which will lead to the implementation of the integrated system. The following plan offers a solution to the development of a meaningful and effective management tool.

Step One -- Develop and implement procedures for road design and insist on compliance. These procedures should be modified and expanded as necessary and feasible. Policies will need to be developed by the Department and the Federal Highway Administration which fix decision making responsibility.

Step Two -- Develop and implement a simple, short-term scheduling system with the following characteristics:

+. Utilize a standard network based on the work flow,

+. Establish major target dates and interim dates to allow monitoring of project status and progress,

+. Involve the road design personnel in the development of project target dates,

+. Report progress with relation to the network, and

+. Monitor and develop manually.

The successful implementation of this step will require the adoption of a policy which indicates that the number one objective is to meet the target dates.

Step Three - Develop and implement a reporting system with the following characteristics:

+. Input reports which combine accounting information with work activity and accomplishment reporting,

+. Output reports which compare initial productivity standards with actual experience, and

+. Collect data and monitor by computer.

The short-term reporting system will not be integrated with the short-term scheduling system.

The effective implementation of the first three steps will require that employees are held responsible for productivity and meeting objectives. It will also require that several persons be assigned sole responsibility to coordinate data and monitor progress.

Step Four -- Move toward stabilizing the five-year program requiring the following:

+. Concerted efforts by outside influences to help stabilize the program including the Department, Federal Highway Administration and the State political forces,

+. Development of more effective cost estimates, and

+. Develop manpower requirements during the short-term period based on project assignments by crew.

Following the steps as outlined in this report will allow the implementation of the integrated system only after (1) the reporting system has generated data to develop standards, (2) the program has stabilized, (3) employees are trained in the scheduling of work by work activities, and (4) the procedures and workflow are proven to be functional. This implementation plan has been developed based on the following considerations:

+. The present program is unstable and this would not allow any sophisticated system to function effectively.

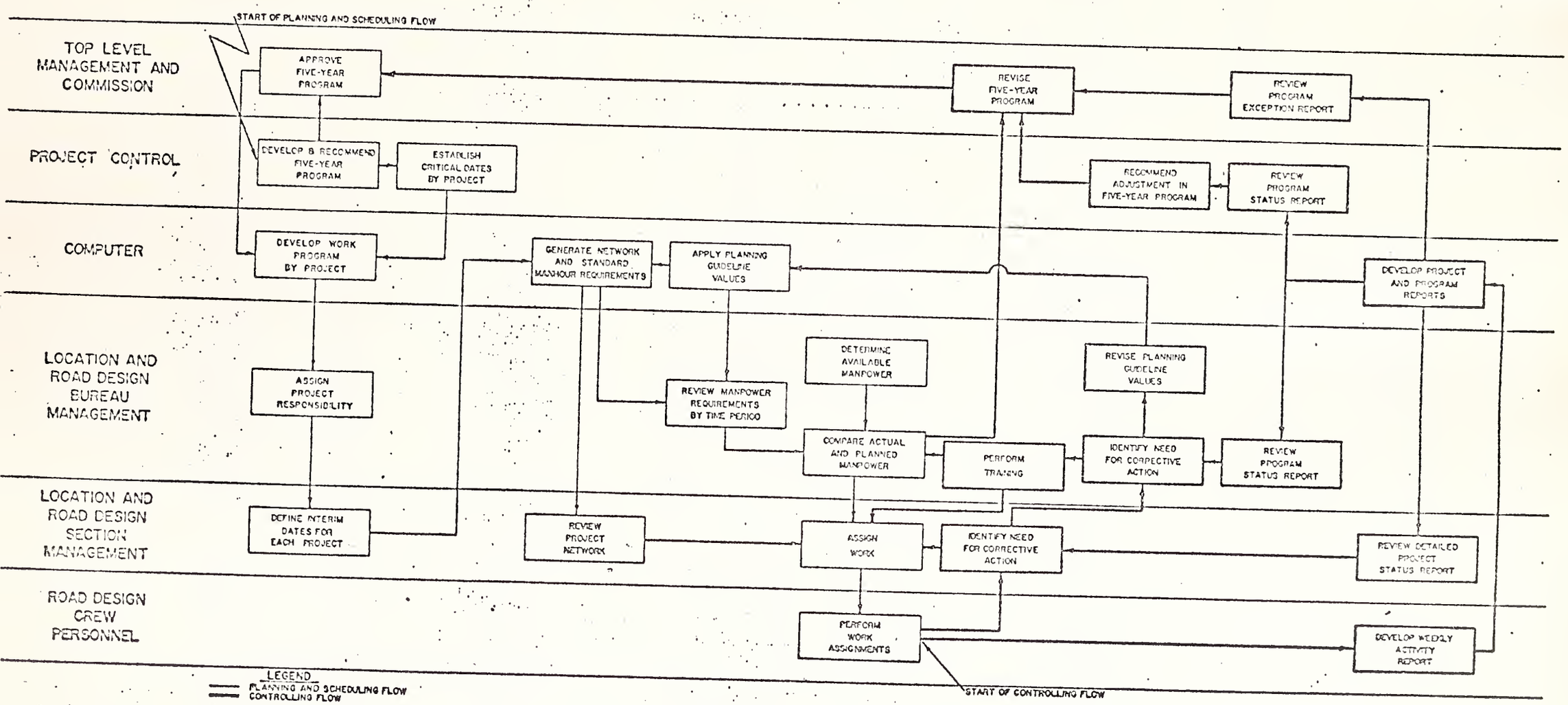
+. The lack of existing data related to the number of manhours required to accomplish specific work causes initial standards to be based on short-term observations and experience. The validity of the initial standards will affect the effectiveness of the sophisticated system.

+. There is a need to develop an engineering-oriented planning function.

+. Initiation of any sophisticated system and it's potential failure would severely bias any further developments.

FIGURE 1

SCHEDULING AND CONTROLLING SYSTEM


START OF PLANNING AND SCHEDULING FLOW
TOP LEVEL MANAGEMENT AND COMMISSION
PROJECT CONTROL
COMPUTER
LOCATION AND ROAD DESIGN BUREAU MANAGEMENT
LOCATION AND ROAD DESIGN SECTION MANAGEMENT
ROAD DESIGN CREW PERSONNEL
APPROVE FIVE-YEAR PROGRAM
DEVELOP & RECOMMEND FIVE-YEAR PROGRAM
ESTABLISH CRITICAL DATES BY PROJECT
DEVELOP WORK PROGRAM BY PROJECT
ASSIGN PROJECT RESPONSIBILITY
DEFINE INTERIM DATES FOR EACH PROJECT
GENERATE NETWORK AND STANDARD MANHOUR REQUIREMENTS
APPLY PLANNING GUIDELINE VALUES
REVIEW MANPOWER REQUIREMENTS BY TIME PERIOD
REVIEW PROJECT NETWORK
DETERMINE AVAILABLE MANPOWER
COMPARE ACTUAL AND PLANNED MANPOWER
ASSIGN WORK
PERFORM WORK ASSIGNMENTS
REVISE FIVE-YEAR PROGRAM
REVIEW PROGRAM EXCEPTION REPORT
RECOMMEND ADJUSTMENT IN FIVE-YEAR PROGRAM
REVIEW PROGRAM STATUS REPORT
REVISE PLANNING GUIDELINE VALUES
PERFORM TRAINING
IDENTIFY NEED FOR CORRECTIVE ACTION
REVIEW PROGRAM STATUS REPORT
IDENTIFY NEED FOR CORRECTIVE ACTION
REVIEW DETAILED PROJECT STATUS REPORT
DEVELOP PROJECT AND PROGRAM REPORTS
DEVELOP WEEKLY ACTIVITY REPORT
START OF CONTROLLING FLOW
LEGEND
PLANNING AND SCHEDULING FLOW
CONTROLLING FLOW

MONTANA DESIGN MANAGEMENT PROJECT
PROGRESS REPORT

May 1, 1971

Work underway during April was directed toward Phases II and III of the project.

PHASE II

Accomplishments in Phase II include: (1) continuation of the testing program for plan standardization work, (2) continuation of development work in the sequencing of activities, (3) continuation of development work for productivity standards, and (4) continuation of the testing period for the standard drawings recommendations.

Plan Standardization Testing

An Associated General Contractor subcommittee reviewed the model plans with department and consultant representatives. Recommendations made during the review are receiving serious consideration. Those found to result in a more effective, legible and uniform set of contract plans will be incorporated in the final product.

Final production of the manual and model plans has been initiated and is expected to be completed during May or early June.

Training required to investigate the potential for using a Veri-type in the development of contract plans has been delayed pending approval for travel out-of-state.

Sequencing of Activities

Work system improvements previously developed are being incorporated into a proposed workflow. The proposed workflow has been developed to document work sequences from the time the field information is transmitted to Preconstruction through to thePreliminary Plan-in-Hand. Further work is required before the work-flow will be final.

Productivity Standards

The analysis of historical data related to manhours and costs required to produce a set of plans is complete. This data will provide a parameter for the development of meaningful standards.

A selective reporting system initiated during February and scheduled to be completed during April is going to be extended into May. Additional data will be required before this element of the data collection for standards development is complete.

Method studies of work being accomplished in the design crews has been initiated. Observations are made of on-the-job work to determine the time required to result in specific amounts of accomplishment. The objectives of the methods studies are to develop estimates of the manhours per work accomplishment and to document the conditions under which the work is completed. Estimates from road design personnel have been encouraged and are being documented.

Standard Drawings

Drafting work on standard drawings and standard sheets is approximately 40 percent complete. Work is intermittent due to required drafting work for the model plans. Drafting work on the standard drawings is considered to be on schedule.

PHASE III

Accomplishments in Phase III include: (1) initiation of development work on a Preconstruction organization, (2) initiation of development work for implementation of a training needs survey, (3) initiation of development work on the Design Management Manual, and (4) initiation of development work on the Design Manual.

Organization

A preliminary functional organization has been developed. This organization has been reviewed with Preconstruction management personnel and top-level Department personnel. Finalization of the organization after the documentation of the functional responsibilities and the position descriptionsprove to be adequate.

Training Needs

The development of an approach to determining training needs for Preconstruction personnel has been initiated. An integration of work sampling results, knowledge, skills and abilities statements, as well as a random sample testing program appears to be feasible. Test questions will be developed to determine needs by work activity as well as specific knowledge, skills and ability requirements.

Design Management Manual

A preliminary outline and partial drafts of material for the Management Manual have been completed. The development of much of the detailed information -- organization, function description, position descriptions, workflows, standards, procedures, etc. -- will be developed under other elements of this contract.

Design Manual

Development work to define (1) a statement of purpose, (2) guidelines for manual preparation including both format and content, (3) a mock-up design manual, and (4) a work plan for manual preparation has been completed. Initial committee meetings to develop specific design criteria will commence in May.

MONTANA DESIGN MANAGEMENT PROJECT

PROGRESS REPORT

April 1, 1971

Work underway during March was directed toward Phases I, II, and III of the project.

PHASE I

Plan Standardization

The testing of the plan standardization recommendations continues. Additional recommendations developed through the course of the work systems improvement work are also being tested.

The Design Management Committee reviewed the progress of the testing program during March. It was determined that a new model set of plans would be developed to communicate additional information to design personnel. Improvements in the format of the presentation will also be incorporated.

Drafting work on two test projects--Cut Bank-West and Cut Bank-South--has been completed. The Oilmont-East project--S-237-- is scheduled to be let to contract in May. Drafting work on two other projects has been delayed pending design developments.

A testing program has been initiated to investigate the potential of using a Veri-type in the development of contract plans. Potentials may exist to produce a more uniform and legible set of contract plans at a lower unit cost for drafting.

Traffic Work Sampling

Work sampling observations in Traffic have been completed and analyzed. An analysis of the findings of the study is attached to this report.

This concludes the work sampling studies of Preconstruction personnel.

PHASE II

Accomplishments in Phase II include: (1) continuation of development work in the sequencing of activities, (2) continuation of development work for productivity standards, (3) continuation of development work for quality standards, (4) continuation of the testing period for the standard drawings recommendations, and (5) initiation of the development of policy statements.

Sequencing of Activities

Preliminary work has been initiated to document the proposed workflow. The detailed workflow is based on the sequencing of the major work activities and the work systems improvements previously documented. Further improvements in the work system are contemplated as a result of the development of the proposed workflow.

The detailed workflow will provide the basis for development of procedure statements.

Productivity Standards

Analysis of historical data related to manhours and costs required to produce a set of plans continues. Preliminary information indicates that this source of data will provide a parameter for the development of meaningful standards.

A selective reporting system has been initiated in road design. Individuals have been required to maintain records of manhours and work accomplishment by work activity. This selective reporting system will be continued through April.

Reporting of selective information will be discontinued when sufficient data have been collected to aid in the development of standards. This short-term system will also provide a test of system elements which are contemplated to be used in a permanent reporting system.

Quality Standards

Work has been initiated to develop checklists for the evaluation of material generated during the design process. These checklist items will be used to ensure that specific points are considered and that the work is accomplished to an acceptable quality level.

Standard Drawings

Drafting work on standard drawings and standard sheets continues. Approximately 30 per cent of the required drafting work has been accomplished. Full implementation of the recommendations has been scheduled for January 1972, however, drafting work is scheduled to be complete in August 1971.

Policy Statements

Preliminary policy statements have been developed for the following items:

1. Preconstruction Planning and Scheduling
2. Preconstruction Planning Guidelines
3. Design Consultant Utilization
4. Preconstruction Reporting System
5. Preconstruction Training

Other subject matter areas will be covered by policy statements as required.

Workload Measurements

Bases have been developed to identify those project features which have significant influence on the time required to design a project. These tentative features will be subject to modification as a result of testing the scheduling system.

Please refer to the attachment--Project Characteristics-- for more complete information.

PHASE III

Accomplishment in Phase III include the distribution of the salary survey report to the participants of the survey.

Tentative personnel classification and salary plans have been developed based on the information defined during the survey.

MONTANA DESIGN MANAGEMENT PROJECT
PROGRESS REPORT
February 1, 1971

Work underway during January was directed toward Phases I, II and III of the project.

PHASE I

Development work in Phase I is complete. The work sampling program in Traffic continues and implementation of standardization work continues.

The drafting work required to conform to the guidelines of the standardization work is 50 per cent complete on two projects; work on two other projects has not yet been initiated. The test period will continue through June, 1971.

The work sampling study for the Traffic Section will be continued for two weeks past the planned completion date -- February 19, 1971 -- due to an insufficient number of observations. Approximately 2,000 observations have been taken to date.

PHASE II

Accomplishments in Phase II included: (1) continuation of work systems improvements and analyses, (2) completion of standard drawings evaluations, (3) initiation of development work for productivity standards.

Work Systems Improvement

A skeleton work flow of the model system has been developed. This will provide the basis for (1) the development of a decision model, and (2) back-chaining to determine the sequencing of major elements.

The decision model will provide the basis for development of policy and procedure statements. Further, the decision model will provide an input for the development of an effective scheduling and controlling system.

Standard Drawings

A policy statement and procedures have been developed and approved to guide the development and utilization of standard drawings and standard sheets. A work plan has been developed and approved which will guide the implementation of this work. Please refer to the attachments for more detailed information.

Productivity Standards

A review of historical charges to design projects by personnel within classifications has been initiated. Utilization of work sampling information and the historical data will serve as alternative parameters for the establishment of standards. Other parameters will be developed through work with design consultants and the Design Management Committee.

A design review trip to Texas has been scheduled for mid-February.

PHASE III

Accomplishments in Phase III included: (1) completion of the salary survey, (2) analysis of the salary data, and (3) development of a tentative classification and salary plan.

A salary survey report will be developed during February.

ROY JORGENSEN ASSOCIATES, INC.

FHWA
c/o Paul DeVine

MONTANA DESIGN MANAGEMENT PROJECT
PROGRESS REPORT
January 1, 1971

Work underway during December was directed toward Phases I, II and III of the project.

PHASE I

Accomplishments in Phase I included: (1) implementation of the testing period for the plans standardization work, (2) finalization of work activity definitions, as well as knowledge, skill, ability and level of difficulty statements for the Traffic Section of the Preconstruction Division, (3) initiation of the work sampling study in the Traffic Section, and (4) completion of the work sampling study for road design. Work in Phase I is complete with the exception of the sampling study in the Traffic Section which was initiated at the request of the Department.

Standardization of Plans

The contract plans for four primary and secondary projects will be prepared to pilot test the decisions set forth in the Guidelines for Preparing Contract Plans - Interim Manual. Further, design and drafting work initiated on new projects undertaken by the Preconstruction Division's design personnel (excluding design by consultants) will be accomplished according to these guidelines. Following the end of the test period-- July 1, 1971-- the effectiveness of the new procedures will be evaluated. Full implementation of contract plan standardization findings will tentatively take place on August 1, 1971.

Work Activities and Skills Analyses

Work activities and knowledge, skill and ability statements have been finalized for the Traffic Section in the Preconstruction Division. Please refer to the attachments for more detailed information.

Levels of Work Difficulty

Work sampling observations in road design have been completed and analyzed. Please refer to the attachments for more detailed information with regards to this analysis.

The work sampling study for the Traffic Section was initiated on December 7, 1970 and will be completed on February 19, 1971, pending no unusual developments. Approximately 1,200 observations have been taken to date.

PHASE II

Accomplishments in Phase II included: (1) continuation of work systems improvements and analyses, and (2) continuation of standard drawings evaluations.

Work Systems Improvement

Preliminary flow charts developed in Phase I of the project are being reviewed and expanded to include all major activities. Detailed flow charts for East and West regions, Office Engineer, and Consultant Design sections of Preconstruction as well as Project Control have been prepared.

Work systems improvement -- back-chaining to determine essential steps and sequencing, policy statements and implementation and testing of the new system --- continues.

Standard Drawings

A meeting with the Standard Drawings Review Committee was held during December. As a result of this meeting, a preliminary policy statement and procedures have been developed to guide the development and utilization of standard drawings and standard sheets. Work on this part of Phase II is expected to be completed in January.

PHASE III

Two elements of the third phase of the project -- the development of a personnel classification plan and terms of employment for Preconstruction -- have been accelerated. Information developed in the project identified the need for a revised classification plan for the Preconstruction Division.

It is recognized that implementation of any revised personnel classification and salary system would be difficult for only a segment of the Commission. Further, the Legislature intends to form and express its intent with regards to these subject matters in the upcoming session. Therefore, it was deemed desirable to demonstrate to the Legislature an alternative to the development of a personnel classification and salary program.

Terms of Employment

A salary survey is being undertaken to (1) provide a basis for evaluating the salary structure in the Preconstruction Division and (2) provide a basis for recommended revisions, if revisions are necessary.

Survey coverage has been set, including the development of lists of employees to contact, methods of making the survey have been determined, forms have been designed and Commission personnel have been trained in methods of gathering the data.

Two methods of data gathering will be used. Employers with offices in states other than Montana will be contacted by a written questionnaire. Each of these employers has recruited personnel in Montana during the past year. All written questionnaires have been mailed.

Montana employers will be contacted by a representative of the Commission who has been trained in salary survey data gathering. In-state interviews are expected to be completed by January 15, 1971.

Preliminary procedures for evaluating returned data have been established and analyses sheets designed.

GENERAL

A meeting was held on December 15, 1970 with representatives of the Federal Highway Administration and members of the Design Management Committee to review the status of the project.

Discussion was directed toward the project schedule and progress made under each of the elements in the schedule.

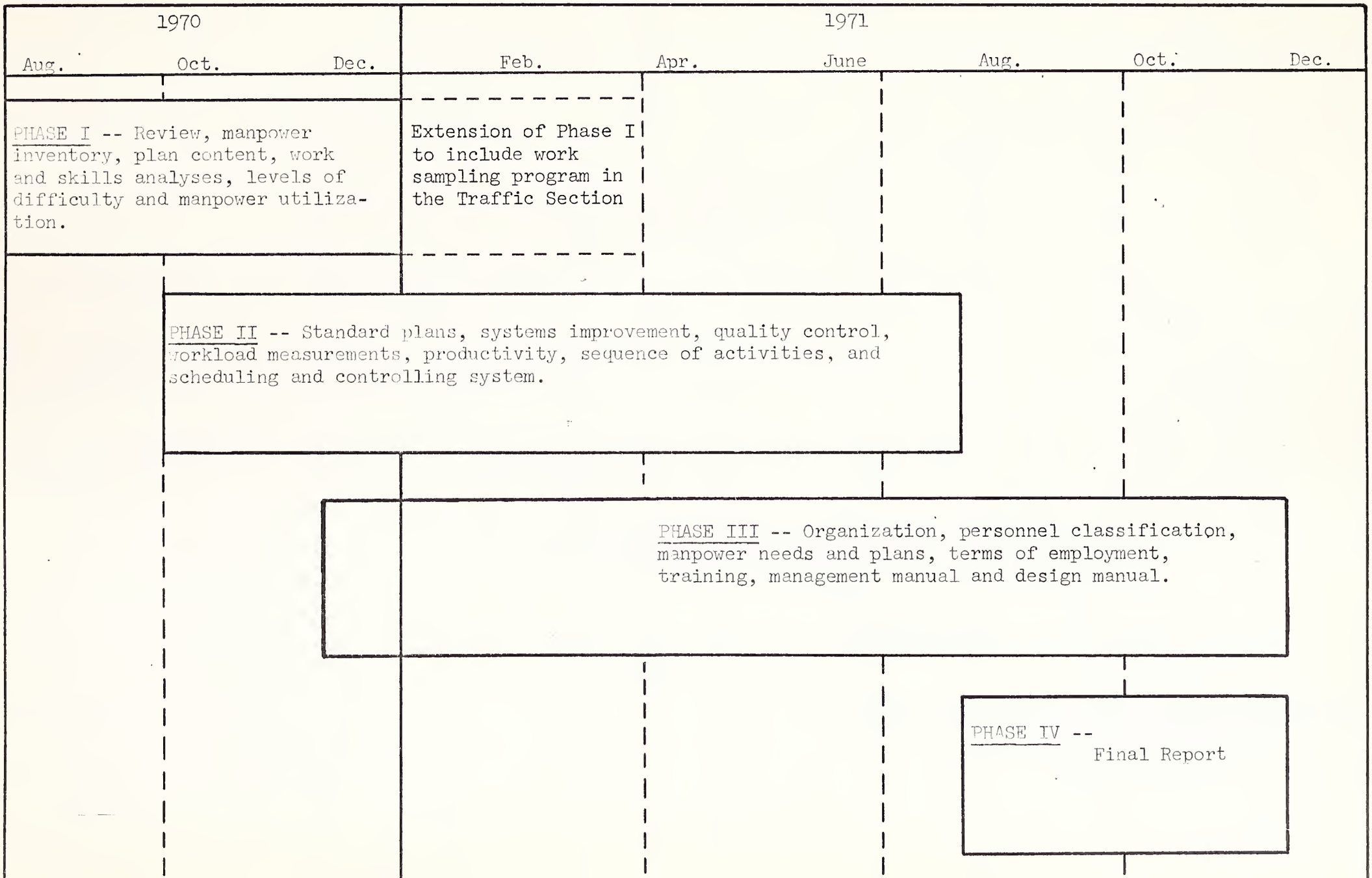
Revised project schedules, required as a result of the acceleration of portions of Phase III and expansion of portions of Phase I, are enclosed.

Montana
State Hi[illegible]y Commission

DESIGN MANAGEMENT RESEARCH PROJECT

SUMMARY SCHEDULE

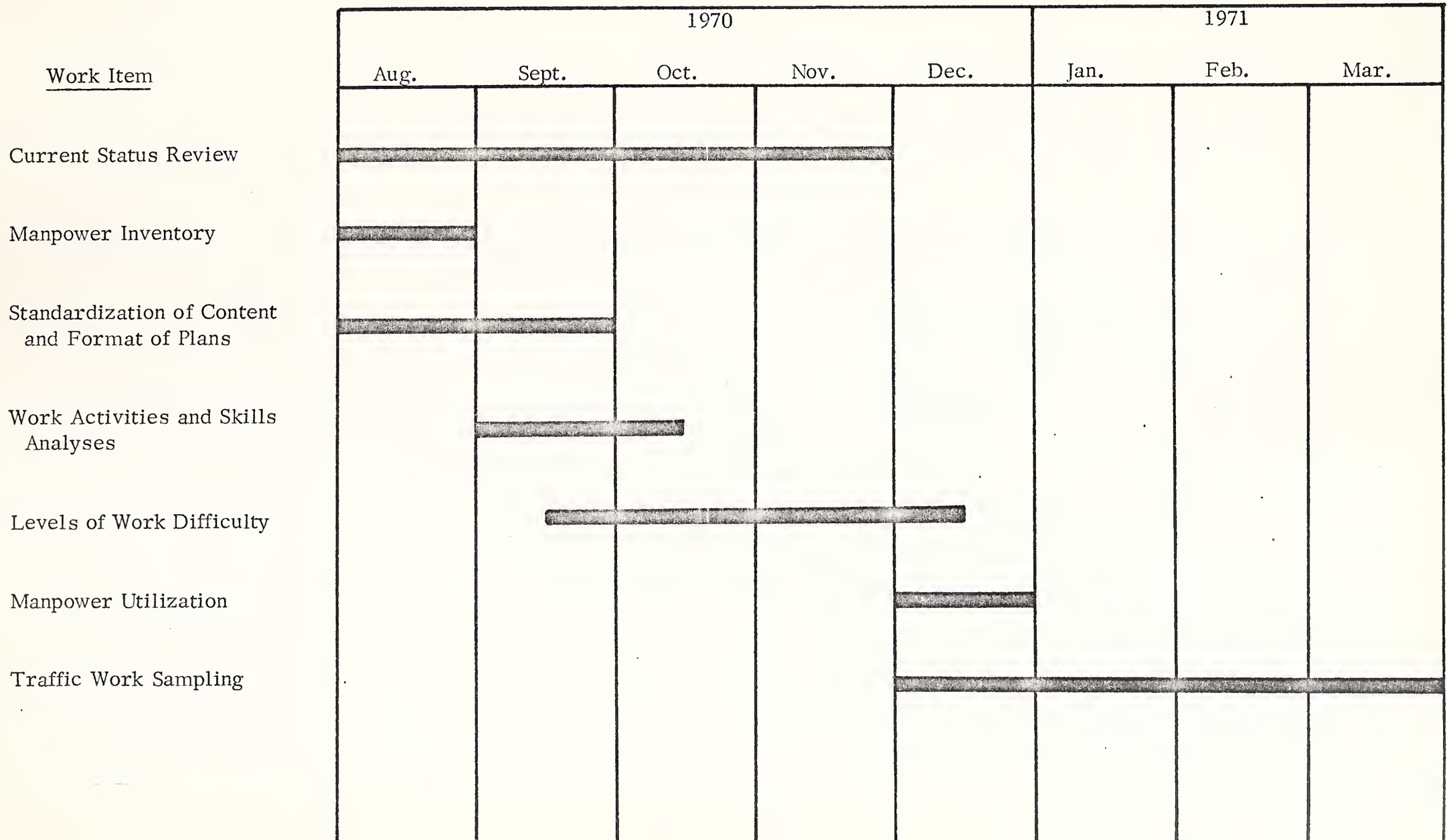
Revised December 1970


1970
1971
Aug.
Oct.
Dec.
Feb.
Apr.
June
Aug.
Oct.
Dec.
PHASE I -- Review, manpower inventory, plan content, work and skills analyses, levels of difficulty and manpower utilization.
Extension of Phase I to include work sampling program in the Traffic Section
PHASE II -- Standard plans, systems improvement, quality control, workload measurements, productivity, sequence of activities, and scheduling and controlling system.
PHASE III -- Organization, personnel classification, manpower needs and plans, terms of employment, training, management manual and design manual.
PHASE IV -- Final Report

Montana
State Highway Commission

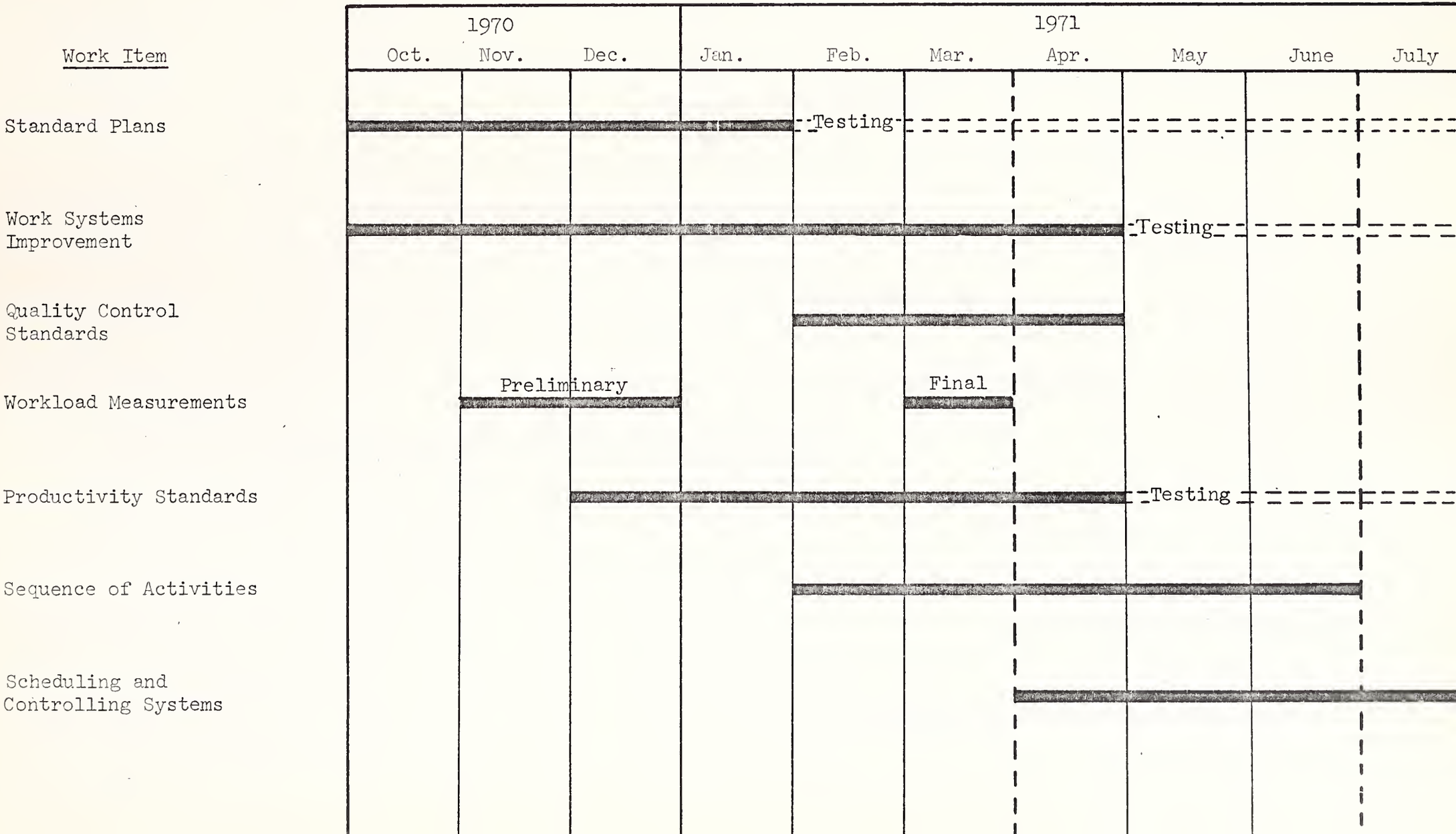
Design Management Research Project
Phase I
Detail Schedule

Revised December 1970



Montana
State Highway Commission

DESIGN MANAGEMENT RESEARCH PROJECT
PHASE II
DETAIL SCHEDULE
Revised December 1970

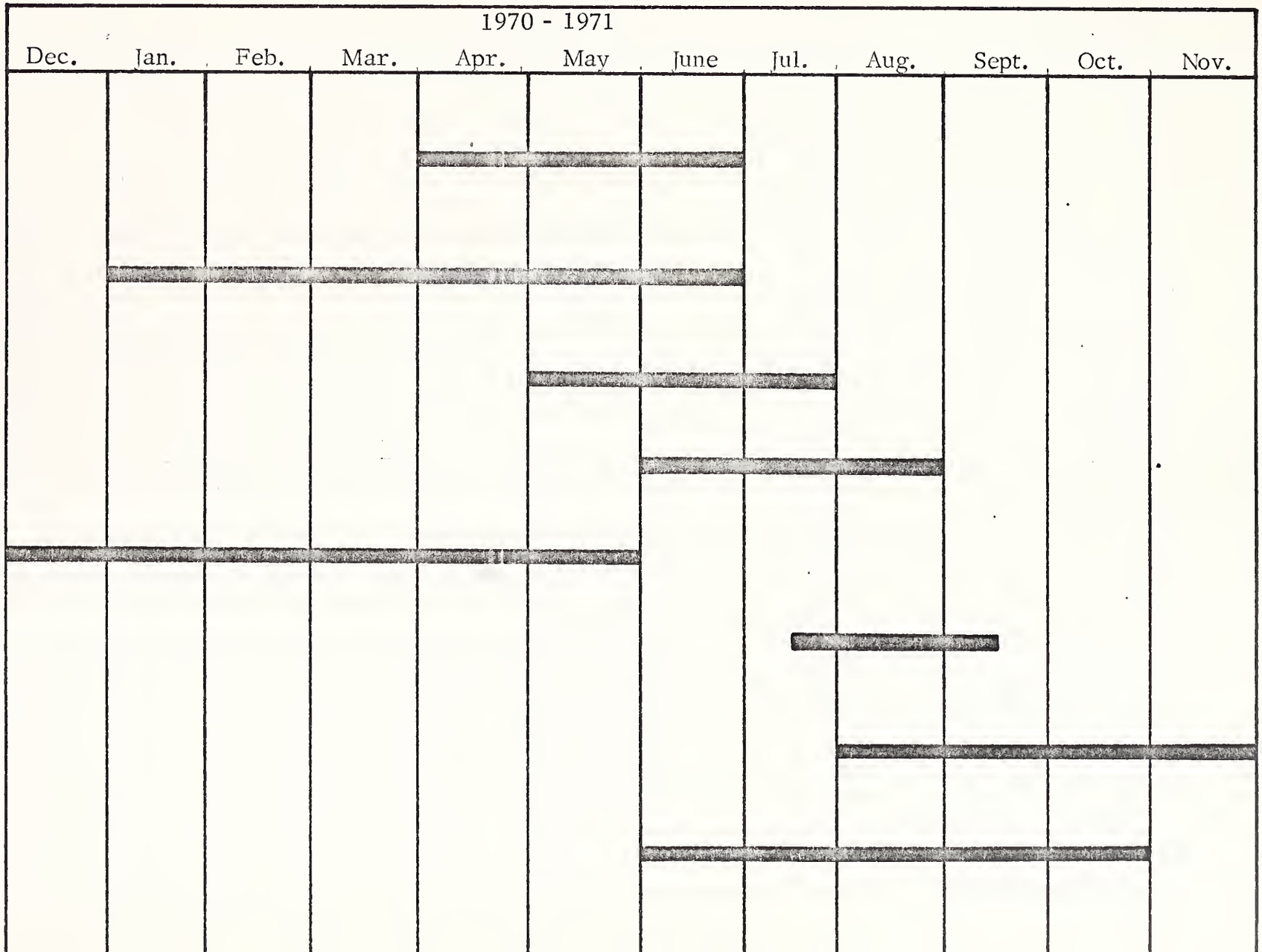


Montana
State Highway Commission

Design Management Research Project

Phase III
Detail Schedule

Revised December 1970



MONTANA DESIGN MANAGEMENT PROJECT
PROGRESS REPORT
December 1, 1970

Work underway during November was directed toward Phase I and Phase II of the project.

PHASE I

Accomplishments in Phase I included: (1) completion of development work on the model set of plans and interim plans standardization manual, (2) initiation of development work for a work sampling study in the Traffic section of the Preconstruction Division, and (3) continuation of work observations.

Standardization of Plans

Management review of the contract plans content and format standardization report has been completed. Department approval has been obtained to implement the findings of the report on a test basis. Implementation of the standardization work on a limited number of ongoing projects and all new projects has been delayed pending the results of a meeting with representatives of the Federal Highway Administration on December 15, 1970.

Drafting of the model set of plans and the preparation of the interim manual has been completed.

Work Activities and Skills Analyses

Work activities and knowledge, skill and ability statements have been completed for the road design functions.

Preliminary work activities and knowledge, skill and ability statements have been defined for the Traffic section of the Preconstruction Division. This development work will be finalized during the first week in December.

Levels of Work Difficulty

Work sampling observations in road design continue. Approximately 12,000 observations have been taken to date. The study will be concluded on December 5, 1970 pending no unusual developments.

The work sampling study for the Traffic section will be initiated on December 7, 1970 and will continue for eleven weeks.

PHASE II

Accomplishments in Phase II included: (1) continuation of work systems improvements analyses, and (2) continuation of standard drawings evaluations.

Work Systems Improvement

Preliminary flow charts developed in Phase I of the project are being reviewed and expanded to include all major activities. Detailed flow charts for East and West regions and the Office Engineers section of Preconstruction as well as Project Control have been prepared.

Further work systems improvement efforts including back-chaining to determine essential steps, development of decision point policy statements, and testing of new systems will continue for the next several months.

Standard Drawings

A questionnaire to determine the utilization of current standard drawings was developed and distributed to members of the Standard Drawings Review Committee. The data has been analyzed and will be presented to the committee for further action in December.

Project Coordinator

Mr. Dean Zinnecker has been appointed to serve as the project coordinator for the project. Mr. Zinnecker is presently serving as the Administrative Assistant to the State Highway Engineer and will serve as a project coordinator on a part-time basis.

ROY JORGENSEN ASSOCIATES, INC.

Management Consultants

MONTANA DESIGN MANAGEMENT PROJECT
PROGRESS REPORT
November 1, 1970

Work underway during October was directed toward Phase I and Phase II of the project.

PHASE I

Accomplishments in Phase I included: (1) continuation of development of model set of plans and interim plans standardization manual, (2) expansion of knowledge, skill and ability statements for road design and directly related activities, (3) completion of work to identify the levels of work difficulty, and (4) continuation of work observations.

Standardization of Plans

Management review of the contract plans content and format standardization report has been completed. Department approval has been obtained to implement the findings of the report on a test basis. Implementation of the standardization work on a limited number of projects is expected to be initiated in November.

Drafting of the model set of plans by the department continues. Preparation of the interim manual for plans standardization has been initiated. Work on the interim manual and model set of plans is expected to be completed in early November.

Work Activities and Skills Analyses

The principal things that people need to know and be able to do to perform effectively each activity have been identifed and indexed for each activity. Based on efforts to define levels of difficulty for the work activities, it was deemed desirable to expand on the knowledge, skill and ability statements previously defined. This work is presently underway and will be completed during the first week in November.

Levels of Work Difficulty

Work sampling observations continue. Approximately one-half of the observations have been taken to date. The study will be concluded on December 5, 1970 pending no unusual developments.

Levels of difficulty for the work activities have been defined. Two committees comprised of management and subordinate department personnel were utilized in the definition procedure. Review of the levels of difficulty and correlation with existing data will continue throughout the work sampling study.

PHASE II

Work on Phase II was initiated in October. Accomplishments included: (1) initiation of work systems improvements analyses, (2) initiation of standard drawings evaluation and (3) selection of a standing Design Management Committee.

Work Systems Improvement

Preliminary flow charts developed in Phase I of the project are being reviewed and expanded to include all major activities. Detailed flow charts are now being prepared.

When completed these charts will provide the bases for commencement of back-chaining to identify ways to re-sequence essential steps, delete unnecessary steps and introduce new methods. This work will be continued for the next several months.

Standard Drawings

A Standard Drawings Review Committee was established (1) to furnish information of present practices with regard to standard drawings, (2) aid in the formulation of alternatives to solve identified problems and (3) to review the findings, conclusions and recommendations of the Consultant.

A questionnaire was developed to aid in the compilation of data related to types of personnel utilizing the existing standard drawings and the extent of that usage. The questionnaire was distributed to members of the Committee and selected subordinate personnel. The data will be analyzed during November.

Design Management Committee

A standing Design Management Committee has been appointed. The functions of this Committee shall include (1) a review of all project recommendations, (2) overall project review and guidance and (3) the formulation of implementation plans and procedures.

ROY JORGENSEN ASSOCIATES, INC.

Management Consultants

MONTANA DESIGN MANAGEMENT PROJECT
PROGRESS REPORT
October 1, 1970

Work underway in September was confined to Phase I of the project. Work in Phase II is scheduled to commence in October.

The project is considered to be essentially on schedule; however, management reviews of the Contract Plans Standardization Report is now expected to take longer than originally scheduled. After management approval is received, a final report on the standardization work will be prepared.

PHASE I

Accomplishments in September included (1) continuation of current status review, (2) completion of reviews of the recommended contract plans standardization work and model set of plans, (3) completion of work activities and skills analyses for road design and directly related activities and (4) initiation of work to identify the levels of work difficulty.

Current Status Review

Work flow data gathering for road design and directly related functions has been completed. Data gathered during September included work flow definitions for road design, landscaping, consultant design, surfacing design and office engineering.

The development of detailed flow charts and review of charts developed by the Department will continue through October.

Standardization of Plans

The draft of the proposed contract plans standardization report and model plans have been reviewed, approved by the Committee, marked up in accordance with their recommendations and presented to management as scheduled. It has appeared desirable to broaden the management reviews beyond those initially anticipated. This is expected to delay preparation of the final report; however, development work is complete.

Drafting of the model set of plans has been turned over to the Department for completion from marked up copies. Department personnel have started this work. It is expected to be completed in October or November.

Work Activities and Skills Analyses

Identification of work activities has been completed for road design, office engineering, consultant design and surfacing design. The principal things that persons need to know and be able to do to perform effectively each activity have been identified and indexed for each activity.

Levels of difficulty will be assigned by knowledgeable Department personnel in a meeting to be held in mid-October.

Levels of Work Difficulty

The design of the work sampling program has been completed. This work included (1) definition of observation procedures, (2) designation of six Department observers, (3) development of random observation times and schedules, (4) development of section, crew and personnel classification coding procedures, (5) development of activity listings and codes, (6) development of observation forms, (7) design of data processing output report formats and (8) initiation of data processing programming by Department personnel.

A general orientation meeting was held with all Preconstruction employees to explain project objectives. Primary orientation was directed toward the work sampling program, its objectives, its meaning to the Preconstruction employees and the basic procedures of the program.

Observers were given an instruction booklet developed by the project staff and training in work sampling.

Work sampling observations were commenced September 28. They will continue for 9 or 10 weeks. Four observations are being taken each day. A total of 15,000 to 17,000 observations are expected by the time the program has been completed.

PHASE II

Work in Phase II of the project is expected to be initiated in October. Work to be undertaken includes commencement of review and evaluation of current systems of standard design plans and commencement of work systems improvement work.

Roy Jorgensen Associates, Inc.

De Graf
Aldridge
Dunbar

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MONTANA DESIGN MANAGEMENT PROJECT

PROGRESS REPORT

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September 1, 1970

On August 3, 1970 a Design Management Research Project was initiated by the Montana State Highway Commission with the guidance and assistance of Roy Jorgensen Associates, Inc., a management consulting firm. The objectives of the project are to (1) design and apply research techniques directed toward improving manpower utilization, work systems and total management systems of road design functions and (2) test the techniques in the Design Division of the Commission.

Monthly project progress reports, of which this is the first, will be prepared by the Consultant and distributed to members of the Commission, the Chief Engineer and other interested management personnel. The progress reports will summarize the accomplishments of the reporting period and will briefly describe the work to be undertaken during the next month. The body of the progress report will be indexed by the major elements of the work plan.

Progress file notebooks will be developed and distributed. The notebooks will facilitate the filing and accumulation of materials developed during the course of the study. They should be available for distribution by October 1.

Project Schedules

Project schedules have been completed and copies are attached to this report. The project has been divided into four phases. The first page is a summary schedule showing the time relationships between each of the four phases and the major work elements of each phase. Pages 2, 3 and 4 are the detailed schedules covering phases one, two and three respectively. The detail schedules show the estimated time requirements of each of the major elements of the work plan and the expected time of completion.

Revised schedules will be prepared and transmitted to progress file holders in the event that work is not completed within the scheduled time or if project modification is required.

PHASE I

All project activities underway in August related to phase one of the work plan. Work in phase two is not expected to be started until October.

Phase one is divided into six major elements. These elements are (1) current status review, (2) manpower inventory, (3) standardization of content and format of contract plans, (4) work activities and skills analyses, (5) levels of difficulty identification and (6) manpower utilization. Work was initiated on the first five of these elements during August. Progress on these activities and immediate plans for the coming month are discussed below.

Current Status Review

This element of the project covers a review of the operating status of the design function. Work accomplished this month includes (1) the selection of a representative sample of 39 road design projects, (2) a comparison of actual road design completions to scheduled completions for the selected sample of projects, (3) an analysis of projects in the sample which were delayed during the period from January 1970 to July 1970, (4) an analysis of sample projects accelerated during the same period, (5) a preliminary analysis of short-range and long-range program performance, (6) a preliminary evaluation of project control techniques, and (7) initiation of work to identify the major elements of road design work flow. The data developed and finalized as a result of this work are attached to this report.

Work to be accomplished in October in this element of the project includes review and completion of summary and detailed work flow charts, initiation if practical, of an analysis of the design costs of a selected sample of comparable projects and commencement of the development of flow charts of project control systems.

The development of meaningful design cost comparisons will be difficult. Current methods of cost accumulation are not readily adaptable to this type of analysis, however this work item will not be abandoned unless proven impractical.

Manpower Inventory

The manpower inventory has been completed. Work accomplished included (1) the development of short range employment trends (2) identification of the characteristics of the work force -- distributions of employees by personnel classification, age, education, department experience and related experience, and (3) identification of the numbers and types of employees leaving the work force in 1968, 1969 and 1970 to date.

Summary charts and data covering the manpower inventory are also attached to this report.

Standardization of Plans

A draft of a proposed contract plans standardization report has been completed and a preliminary model set of plans is nearing completion in a rough marked-up draft form. The report and model set of plans are the results of improvement decisions of a Committee of Preconstruction personnel with the guidance and assistance of the Consultant. The proposed revisions have been summarized and discussed with a representative of the Bureau of Public Roads.

Work remaining on this item includes drafting of the model set of plans and review of the standardization report by the Committee and Preconstruction. This work is scheduled for completion in September. The standardization report and model set of plans will then be recommended to the Department for adoption and implementation.

Work Activities and Skills Analyses

Work on this element of the project was initiated by a review of similar work in other states. This review has been completed and a preliminary composite of typical activities developed.

Work to be undertaken in September includes the definition of Montana work activities and the knowledge, skills and abilities necessary to effectively perform the activities of road design.

Levels of Difficulty

After the work activities of road design have been completed they will be ranked by relative level of difficulty. This work will be initiated by mid-September.

PHASE I

FIGURE 1

ROAD DESIGN

SUMMARY OF LEVELS OF DIFFICULTY

(DECEMBER 7, 1970 THROUGH MARCH 5, 1971)

DIRECT & SUPPORTING ACTIVITIES 1/	NUMBER OF OBSERVATIONS	% OF GROUP	% OF TOTAL
Level One	233	12.0	5.1
Level Two	541	27.8	11.9
Level Three	142	7.3	3.1
Level Four	387	19.9	8.5
Level Five	644	33.0	14.1
Subtotal	1,947	100.0	42.7
LEVELS NOT DEFINED			
Supporting & Nonproductive Activities	2,268	86.7	49.7
Leave	349	13.3	7.6
Subtotal	2,617	100.0	57.3
Total	4,564		100.0

1/ Includes all activities which have a level of difficulty assigned.

FIGURE 2

TRAFFIC

LEVELS OF DIFFICULTY

BY PERSONNEL CLASSIFICATION

(DECEMBER 7, 1970 THROUGH MARCH 5, 1971)

PERSONNEL CLASSIFICATION	NUMBER OF OBSERVATIONS[1]	- - -LEVELS OF DIFFICULTY- - - (PERCENT) ONE	TWO	THREE	FOUR	FIVE
Draftsman II	242	18%	62%	9%	7%	4%
Draftsman III	481	21	44	8	22	5
Detailer I	624	8	23	8	26	35
Designer I [2]	174	11	14	9	8	58
Designer II	252	5	2	3	18	72
Designer III And Engineer-in-Training [2]	174	1	5	3	25	66
Totals and Averages	1,947	12%	28%	7%	20%	33%

1/ Includes all activities which have a level of difficulty assigned--direct work activities and selected supporting activities.

2/ One person was transferred into Traffic as a Designer I and one Engineer-in-Training was transferred out of Traffic during the study.

FIGURE 3

TRAFFIC

AVERAGE LEVEL OF DIFFICULTY

FOR DIRECT AND SUPPORTING ACTIVITIES

BY PERSONNEL CLASSIFICATION

PERSONNEL CLASSIFICATION	NUMBER OF OBSERVATIONS	WEIGHTED AVERAGE LEVEL OF PERFORMANCE
Draftsman II	242	2.2
Draftsman III	481	2.5
Detailer I	624	3.6
Designer I 1/	174	3.9
Designer II	252	4.5
Designer III and Engineer-in-Training 1/	174	4.5

1/ One person was transferred into Traffic as a Designer I and one Engineer-in-training was transferred out of Traffic during the study.

FIGURE 4

MANPOWER STAFFING ANALYSIS FOR ROAD DESIGN

LEVEL OF DIFFICULTY AND CLASSIFICATION	WORK LOAD DISTRIBUTION PER WORK SAMPLING (PERCENT)	NUMBER OF PERSONS	PERCENT OF FORCE	DEVIATION FROM WORK LOAD (PERCENT)	CUMULATIVE DEVIATION 1/ FROM WORK LOAD (PERCENT)	NUMBER OF PERSONS	PERCENT OF FORCE	DEVIATION FROM WORK LOAD (PERCENT)	CUMULATIVE DEVIATION 1/ FROM WORK LOAD (PERCENT)
Level Five	33								
Engineers		1	18	-15	-15	2	32	-1	-1
Designer III		3				5			
Level Four	20								
Designer II		3	14	- 6	-21	4	18	-2	-3
Level Three	7								
Designer I		2	9	+ 2	-19	2	9	+2	-1
Level Two	28								
Detailer I		6	45	+17	- 2	4	27	-1	-2
Draftsman III		4				2			
Level One	12								
Draftsman II		3	14	+2	0	3	14	+2	0
Total Engineers		1				2			
Total Technicians		21				20			
Total Personnel		22				22			

1/ The assumption is made that the deviation will be cumulative. In actual situations, persons in the higher classifications usually will perform work in each of the lower levels of difficulty, causing the deviations to increase over those shown. Also, any deviation from these averages toward [illegible]emporary increase in the engineering work load w[illegible] increase [illegible] need for engineers in proposition to technician[illegible]

File under Phase I

MANPOWER UTILIZATION

ROAD DESIGN

INTRODUCTION

Work sampling is a fact finding tool. It is a technique which is based on the taking of a large number of observations at random times.

The work sampling program undertaken in the road design function of the Preconstruction Division had three principal objectives. These objectives are as follows:

1. To determine the characteristics, distribution and frequency of road design work activities.

2. To relate observed work activities by level of difficulty to the classifications of personnel performing the work.

3. To relate existing staffing patterns to observed optimum staffing patterns.

The results of the road design work sampling study are shown in Figures 1 through 6. The balance of the enclosures show work activity level of difficulty and knowledge, skill and ability statements for both road design and traffic engineering.

SUMMARY OF LEVELS OF DIFFICULTY

Figure 1

This figure illustrates the characteristics of the design work load by level of difficulty. The data indicated that approximately 43per cent of the on-the-job time spent by design personnel was utilized in direct production or those supporting activities for which a level of difficulty could be assigned. The data also indicated that 57 per cent of the time was spent in indirect nonproductive and other supporting activities as well as on leave. The time spent on direct and supporting activities -- those which are assigned a level of difficulty -- is of prime concern.

Level one work -- that work which can be performed by personnel with little or no experience -- comprised approximately 9 per cent of the total work. Further, this type of work comprises approximately 21 per cent of the direct and supporting work load.

Level two work -- that work which can be performed by personnel with limited experience -- comprised 5 per cent of the total work and 12 per cent of the direct and supporting work load.

Level three work -- that work which can be performed by experienced technician personnel requiring close supervision -- comprised 8 per cent of the total work and 19 per cent of the direct and supporting work load.

Level four work -- that work which can be performed by technician personnel requiring limited supervision -- comprised 5 per cent of the total work and 11 per cent of the direct and supporting work load.

Level five work -- that work which can be performed by high level technician or engineering personnel responsible for project design -- comprised 16 per cent of the total work and 38 per cent of the direct and supporting work load.

FIGURE 1

ROAD DESIGN

SUMMARY OF LEVELS OF DIFFICULTY

(SEPTEMBER 28, 1970 THROUGH DECEMBER 4, 1970)

DIRECT & SUPPORTING ACTIVITIES[1/]	NUMBER OF OBSERVATIONS	% OF GROUP	% OF TOTAL
Level One	1,323	20.6	8.8
Level Two	803	12.5	5.4
Level Three	1,192	18.6	7.9
Level Four	678	10.6	4.5
Level Five	2,418	37.7	16.1
Subtotal	6,414	100.0	42.8
LEVELS NOT DEFINED			
Supporting & Nonproductive Activities	6,482	75.5	43.2
Leave	2,102	24.5	14.0
Subtotal	8,584	100.0	57.2
Total	14,998		100.0

1/ Includes All Activities Which Have A Level Of Difficulty Assigned.

LEVELS OF DIFFICULTY BY PERSONNEL CLASSIFICATION

Figure 2

This figure illustrates the distribution of direct work activities and selected supporting activities accomplished by the personnel classification studied. The distribution of work by level of difficulty varied from 10 per cent to 38 per cent as illustrated in Figure 1 and the average percents in Figure 2.

The distribution of work for each of the classifications is illustrated by the percentages of work effort by level of difficulty. It is important to note that the majority of the classifications performed work in each of the levels of difficulty. (There were no level one work activities for Office Engineer personnel.) Ideally, each of the personnel in a classification would perform work only in the highest level of difficulty which his capability permitted. Realistically, variations from this optimum are common and to be expected. To a limited extent, personnel can perform adequately work at higher levels than those normally associated with their personnel classification when receiving very close supervision.

Variations to the extent indicated in Figure 2 can be caused by at least two situations (1) crew staffing patterns not developed to match the existing work load, and (2) personnel not properly classified according to their capability to perform.

FIGURE 2

ROAD DESIGN

LEVELS OF DIFFICULTY

BY PERSONNEL CLASSIFICATION

(SEPTEMBER 28, 1970 THROUGH DECEMBER 4, 1970)

PERSONNEL CLASSIFICATION	NUMBER OF OBSERVATIONS[1]	LEVELS OF DIFFICULTY (PERCENT) ONE	TWO	THREE	FOUR	FIVE
Draftsman I and II	1,195	52%	11%	18%	9%	10%
Draftsman III	1,143	40	22	23	6	9
Detailer I and II	907	15	15	16	17	37
Designer I	861	5	11	22	15	47
Designer II	639	4	8	16	17	55
Designer III	920	1	7	9	8	75
Engineer-in-Training[2]	183	23	32	15	3	27
Estimates Supervisor I and III	280	--	2	55	6	37
Area Engineer, Special Assignments Engineer I and Contract Plans Manager	286	--	3	5	1	91
Totals and Averages	6,414	21%	12%	19%	10%	38%

1/ Includes All Activities Which Have A Level Of Difficulty Assigned -- Direct Work Activities And Selected Supporting Activities.

2/ Four Personnel Were Transferred Out Of Preconstruction And One Person Was Transferred Into Preconstruction During The Study.

AVERAGE LEVEL OF DIFFICULTY

BY PERSONNEL CLASSIFICATION

Figures 3 & 4

Figure 3 illustrates the weighted average level of performance for direct and selected supporting activities for each of the personnel classifications studied.

The average level of performance increases from the Detailer I classification through the Designer III classification. Work performed by personnel in the Engineer-in-Training classification was performed at an average level of performance less than that of the Detailer I and II classifications.

Personnel in the administrative classifications -- Area Engineer, Special Assignments Engineer I and Contract Plans Manager -- performed work at the highest average level of performance.

Figure 4 illustrates the per cent of direct work activities and selected supporting activities -- those activities to which a level of difficulty could be assigned -- by levels of difficulty performed by engineers and technicians. For the purposes of this analysis, Engineers were defined as graduates in directly related engineering curriculum and those with E.I.T. status or Professional Engineering license.

The bar graph indicates the relative amounts of work performed in each of the levels of difficulty by both the engineers and technicians. For example, 22 per cent of the work performed in the highest level of difficulty as opposed to 1 per cent in the fourth level of difficulty and 4 per cent in the lowest level of difficulty. It should be noted, that the work performed by the personnel in the Engineer-in-Training classification was at a lower average level of difficulty than that of the other Engineer classifications.

FIGURE 3

ROAD DESIGN

AVERAGE LEVEL OF DIFFICULTY

FOR DIRECT AND SUPPORTING ACTIVITIES

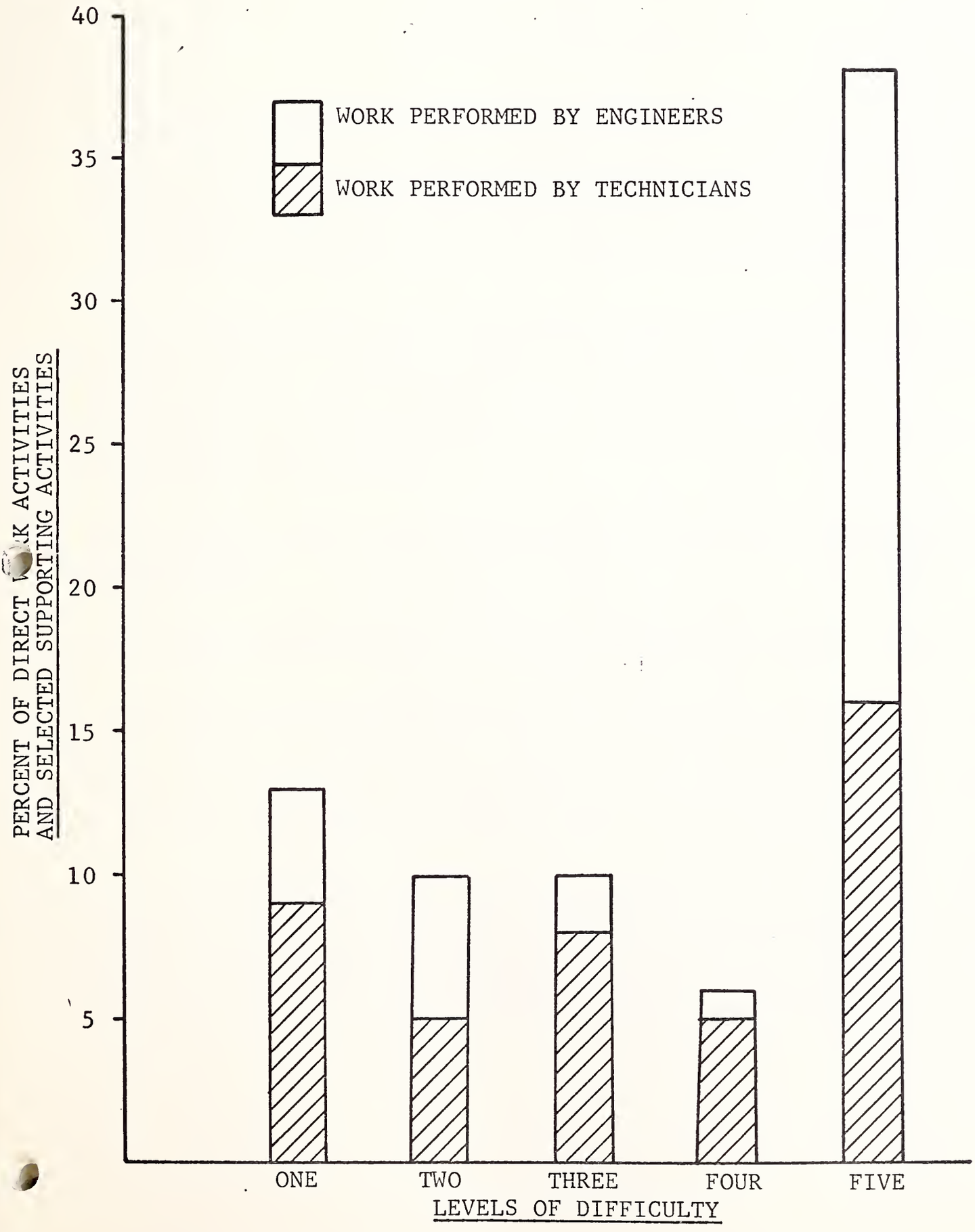
BY PERSONNEL CLASSIFICATION

PERSONNEL CLASSIFICATION	NUMBER OF OBSERVATIONS	WEIGHTED AVERAGE LEVEL OF PERFORMANCE
Draftsman I and II	1,195	2.2
Draftsman III	1,143	2.2
Detailer I and II	907	3.4
Designer I	861	3.9
Designer II	639	4.1
Designer III	920	4.5
Engineer-v-Training 1/	183	2.8
Estimates Supervisor I and III	280	3.8
Area Engineer, Special Assignments Engineer I And Contract Plans Manager	286	4.8

1/ Four Personnel Were Transferred Out Of Preconstruction And One Person Was Transferred Into Preconstruction During The Study.

FIGURE 4

LEVELS OF DIFFICULTY
PERFORMANCE BY CLASSIFICATION GROUP



STAFFING ANALYSIS

Figures 5 and 6

The characteristics of the design work load, as documented by work sampling, indicated that (1) 38 per cent of the work was performed in the highest level of difficulty, (2) 10 per cent was performed in the fourth level of difficulty, (3) 19 per cent was performed in the third level of difficulty, (4) 12 per cent was performed in the fourth level of difficulty, and (5) that 21 per cent was performed in the lowest level of difficulty. A correctly developed staffing pattern would balance a properly classified staff with the work to be accomplished.

The existing staffing pattern is out of balance with the work load distribution as documented by the work sampling program. For example, there are 6 Engineers and 14 Designers which represents 27 per cent of the total personnel -- a deviation of 11 per cent from the work load requirement. Further, there are 9 Detailers I and 13 Draftsmen III representing 29 percent of the total staff and a deviation of 17 per cent from the work load distribution.

An alternative staffing pattern is shown which utilizes approximately the same number of total personnel. This staffing pattern represents a staff balanced with the work to be accomplished.

The work load distribution and the existing staffing pattern shown in Figure 6 duplicates the data shown on Figure 5, but demonstrates alternates in the number of persons employed.

A different staffing pattern alternative is depicted which is based on a total staff of 65 -- a 15 per cent reduction from the first staffing pattern alternative. The staffing pattern is still balanced to the work load distribution. The point of these alternative staffing patterns is to demonstrate that given a decision establishing the total number of personnel, work sampling will allow one to develop a balanced staffing pattern.

It is important to recognize that the work load distribution was documented under the existing work system. A portion of the current contract is directed toward work systems improvements, and may result in changing the work load distribution to a significant degree. Therefore, no staffing recommendations are made now. However, initial steps can be taken to adjust staffing levels and to evaluate personnel classification and manpower management practices with the assistance of the work sampling results.

FIGURE 5

MANPOWER STAFFING ANALYSIS FOR ROAD DESIGN

LEVEL OF DIFFICULTY AND CLASSIFICATION	WORK LOAD DISTRIBUTION PER WORK SAMPLING (PERCENT)	EXISTING STAFFING PATTERN				STAFFING PATTERN ALTERNATIVE			
		NUMBER OF PERSONS	PERCENT OF FORCE	DEVIATION FROM WORK LOAD (PERCENT)	CUMULATIVE DEVIATION 1/ FROM WORK LOAD (PERCENT	NUMBER OF PERSONS	PERCENT OF FORCE	DEVIATION FROM WORK LOAD (PERCENT)	CUMULATIVE DEVIATION 1/ FROM WORK LOAD (PERCENT)
Level Five	38								
Engineers		6	27	-11	-11	9	38	0	0
Designer III		14				20			
Level Four	10								
Designer II		7	9	- 1	-12	8	11	+1	+1
Level Three	19								
Designer I		11	16	- 3	-15	12	18	-1	0
Detailer II		1				2			
Level Two	12								
Detailer I		9	29	+17	+ 2	4	13	+1	+1
Draftsman III		13				6			
Level One	21								
Draftsman II		13	19	- 2	0	13	20	-1	0
Draftsman I		1				2			
Total Engineers		6				9			
Total Technicians		69				67			
Total Personnel		75				76			

1/ The Assumption Is Made That The Deviation Will Be Cumulative. In Actual Situations, Persons In The Higher Classifications Usually Will Perform Work In Each Of The Lower Levels Of Difficulty, Causing The Deviations To Increase Over Those Shown. Also, Any Deviation From These Averages Toward Temporary Increase In The Engineering Work Load Will Increase The Need For Engineers In Proportion To Technicians.

FIGURE 6

MANPOWER STAFFING ANALYSIS FOR ROAD DESIGN

LEVEL OF DIFFICULTY AND CLASSIFICATION	WORK LOAD DISTRIBUTION PER WORK SAMPLING (PERCENT)	EXISTING STAFFING PATTERN				STAFFING PATTERN ALTERNATIVE			
		NUMBER OF PERSONS	PERCENT OF FORCE	DEVIATION FROM WORK LOAD (PERCENT)	CUMULATIVE DEVIATION[1] FROM WORK LOAD (PERCENT)	NUMBER OF PERSONS	PERCENT OF FORCE	DEVIATION FROM WORK LOAD (PERCENT)	CUMULATIVE DEVIATION[1] FROM WORK LOAD (PERCENT)
Level Five	38								
Engineers		6	27	-11	-11	8	38	0	0
Designer III		14				17			
Level Four	10								
Designer II		7	9	- 1	-12	7	11	+1	+1
Level Three	19								
Designer I		11	16	- 3	-15	10	19	0	+1
Detailer II		1				2			
Level Two	12								
Detailer I		9	29	+17	+ 2	3	12	0	+1
Draftsman III		13				5			
Level One	21								
Draftsman II		13	19	- 2	0	11	20	-1	0
Draftsman I		1				2			
Total Engineers		6				8			
Total Technicians		69				57			
Total Personnel		75				65			

1/ The Assumption Is Made That The Deviation Will Be Cumulative. In Actual Situations, Persons In The Higher Classifications Usually Will Perform Work In Each Of The Lower Levels Of Difficulty, Causing The Deviations To Increase Over Those Shown. Also, Any Deviation From These Averages Toward Temporary Increase In The Engineering Work Load Will Increase The Need For Engineers In Proportion To Technicians.

WORK ACTIVITIES

LEVELS OF DIFFICULTY

KNOWLEDGE, SKILL AND ABILITY STATEMENTS

The balance of the enclosures cover a total listing of the work activities used in the work sampling study. The levels of difficulty assigned to each activity and representative statements of the knowledge, skills and abilities required to effectively perform each activity.

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR ROAD DESIGN ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Checking Notes Preparatory to Plotting 1. Checking bench level notes and cross-section levels 2. Checking alignment data	3	Knowledge 1. Of the basic principles of surveying--terminology, level notes; bearings and angles. 2. Of basic mathematics--arithmetic--and limited highway trigonometry-curves, triangles and functions. Skill and Ability 1. To check field notes for completeness and logic.
Plotting Survey Data--Aerial and Land 1. Plotting alignment, topography and profiles 2. Checking plotted data	2	Knowledge 1. Of basic mathematics--arithmetic--and limited trigonometry--angles, functions, coordinates and table interpretations. 2. Of design scales--horizontal and vertical. 3. Of design symbols--signs, culverts, poles, etc. Skill and Ability 1. To print words and figures legibly. 2. To perform basic highway drafting--straight and curved lines, line weights, etc.
Plotting Cross Sections 1. On cross section sheets 2. Checking plotted data	1	Knowledge 1. Of basic arithmetic--count, add and subtract. 2. Of design scales--horizontal and vertical. Skill and Ability 1. To print words and figures legibly. 2. To perform basic drafting--straight lines, line weights, and legible lettering. 3. To visualize shapes--ground line, irrigation; drainage and dimensions.

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR ROAD DESIGN ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Templating Cross Sections 1. Templating the plotted cross sections 2. Checking templating.	3	Knowledge 1. Of design standards and accepted practices--slope standards, superelevations, roundings, run-off, etc. 2. Of design scales--horizontal and vertical. Skill and Ability 1. To make technical judgments on slopes, changes in profiles, curves and drainage. 2. To spot irregularities in drainage, alignment and grade lines. 3. To perform basic drafting--straight lines, line weights, etc.
Designing Typical Sections 1. Designing sections 2. Calculating quantities from typical sections 3. Arranging quantity data	5	Knowledge 1. Of typical section design standards. 2. Of basic mathematics--arithmetic--highway trigonometry--angles, functions--and geometric figures--triangles. 3. Of design scales--horizontal and vertical. Skill and Ability 1. To interpret basic design data and apply those data to design of typical sections--structural thickness, traffic counts and design speeds, standards, program documents and plan-in-hand reports. 2. To make basic logic checks on construction material types.
Design Alignment and Grade 1. Determining vertical and horizontal location 2. Determining intersection points, grade lines, etc. 3. Determining balance points 4. Recording data on plan and profile sheets	7	Knowledge 1. Of application of design standards--curve selection, design speed, beautification, drainage and right-of-way requirements. 2. Of highway trigonometry--spirals and tables. 3. Of alignment evaluations--costs of alternate curves, space, roadway user costs, special problems (rivers and railroads) and "fish and wildlife conservation". 4. Of existing soil, topography and weather data. Skill and Ability 1. To interpret and apply data processing output information. 2. To select optimum alternative. 3. To visualize the affects of alternate balance points.

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR ROAD DESIGN ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Computing Grade Lines 1. Working with grade line data on "dirt sheet"	2	Knowledge 1. Of basic mathematics--arithmetic. 2. Of vertical curve formulae--sags and crests. 3. Of "dirt sheets" and their completion. Skill and Ability 1. In calculator and/or slide rule operation. 2. To visualize effects of grade lines computations.
Designing Intersection, Rest Area, Scale and Interchange Geometrics 1. Designing feature plan and profile 2. Designing Median turn-arounds 3. Designing non-standard approaches 4. Recording data on plans	7	Knowledge 1. Of the application of design standards--curves, speeds, drainages, rights-of-way and beautification. 2. Of basic mathematics--coordinates and arithmetic--and highway trigonometry--functions, curves, tables and spirals. 3. Of traffic flow and geometrics--turning movements, safety standards and origin-destination studies. 4. Of plans and programs status. Skill and Ability 1. To interpret and apply data processing output information--geometric and mainline earthwork runs. 2. To visualize and apply grade lines to existing topography.
Designing Contour Grading 1. For interchanges, rest areas and scales 2. Recording data on plans	4	Knowledge 1. Of principles of contour lines--contour intervals, interpreting slopes and elevations. 2. Of highway drafting--geometric layouts and contour drafting. Skill and Ability 1. To read and interpret plan and profile views, drainage, beautification plans and cross sections. 2. To visualize the finished product with relation to designed features and topography. 3. To apply aesthetic practices with relation to contour grading.

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR ROAD DESIGN ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Designing Miscellaneous Features 1. Guard rail 2. Bituminous curb 3. Standard approaches 4. Embankment protectors 5. Recording data on plans	4	Knowledge 1. Of interpretation and application of applicable design features with relation to physical features. 2. Of safety requirements--location and hazardous conditions. 3. Of alternate materials and locations. 4. Of basic mathematics--simple formulae, graphs and arithmetic. 5. Of drainage features of project. Skill and Ability 1. To draft designed features on plans and cross sections.
Designing Clearing and Grubbing Details 1. Determine foliage type and density 2. Specifying removal 3. Recording data on plans	3	Knowledge 1. Of clearing and grubbing standard specifications. 2. Of basis of payment for clearing and grubbing--lump sum, unit cost and those included in other bid items. Skill and Ability 1. To interpret vegetation types and densities from aerial photos or field notes. 2. To determine areas and summarize quantities--planimetering areas or by formula
Designing Fencing 1. Type determination--wire, post, panel, etc. 2. Recording data on plans	4	Knowledge 1. Of fencing standards and policies. 2. Of maintenance requirements and materials. 3. Of location--control of access and/or right-of-way line--panel placement and terrain. 4. Of right-of-way consideration and/or agreements. 5. Of basic plan reading--symbols, location of features and construction limits. 6. Of basic mathematics--conversions and arithmetic. Skill and Ability 1. To read and interpret topography field notes.

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR ROAD DESIGN ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Plotting Drainage on Plan and Profile 1. Based on recommendations of others	2	Knowledge 1. Of standard practices for plotting drainage--flow lines, skew diagrams, placement of notes, riprap, bank protection. Skill and Ability 1. To print numbers and figures legibly. 2. To perform very basic drafting--straight lines. 3. To read cross sections--flow line and pipe information.
Designing Drainage 1. Pipe size--diameter, gauge and length 2. Location and drainage grade 3. Placement of ditch blocks 4. Recording data on cross sections	5	Knowledge 1. Of basic hydraulics--pipe Q, velocity and head. 2. Of interpretation and application of standards--right-of-way and drainage standards, and tables--hydraulic, fill or cover, and gauge. 3. Of design standard limitations and special problems--cross drainage flow, and irrigation. 4. Of engineering evaluations--pipe materials, types and locations of facilities. 5. Of basic mathematics--volumes, areas and arithmetic. 6. Of highway trigonometry--tables and functions. 7. Of soil reports--reaction of soil types to pipe material types. Skill and Ability 1. To visualize flow line and channel changes. 2. To design drainage to fit existing features.
Preparing Preliminary Estimates 1. Unit cost estimates 2. Project cost estimates 3. Justification estimates--Right-of-Way requests for pipe, frontage road or land service facility information	5	Knowledge 1. Of alternate designs--physical features and material quantities. 2. Of development of project cost estimates--unit prices and cost computations. 3. Of basic mathematics--arithmetic. 4. Of maintenance costs. Skill and Ability 1. To make engineering judgments weighing alternatives with total awareness of factors affecting costs.

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR ROAD DESIGN ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Preparing Displays and Illustrations 1. Public hearings and Joint Development Council 2. Mosaics and autoscreens	2	Knowledge 1. Of methods of presentation preparations. 2. Of drafting materials and supplies. Skill and Ability 1. In the development of artistic presentation materials. 2. To perform basic drafting legibly. 3. To follow written and oral instructions closely. 4. To draft to scale.
Participating in Field Trips 1. Plan-in-hand inspections, field reviews, location public hearings and design public hearings	7	Knowledge 1. Of specifications, design standards and special provisions. 2. Of plans in detail--content of plans and design decision criteria. 3. Of project history. 4. Of policies--Department design Skill and Ability 1. In effective Department and Public relations. 2. To evaluate the effects of proposed changes--design policies, schedules and engineering economics. 3. To communicate effectively. 4. To visualize plans and changes.
Computing Areas 1. With planimeter or by computation--not to include right-of-way areas of taking	1	Knowledge 1. Of basic mathematics--conversions and arithmetic. 2. Of planimeter operation and limitations--size of areas. Skill and Ability 1. In planimeter operation. 2. In accurate calculator operation. 3. To read vernier scales on planimeter.

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR ROAD DESIGN ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Computing Right-of-Way Areas of Taking 1. Break area into geometric shapes 2. Determine area using formulas	3	Knowledge 1. Of basic mathematics--areas, conversions and arithmetic. 2. Of trigonometry--functions, tables and curves. 3. Of plan reading--ownerships, centerline projections and right-of-way limits. Skill and Ability 1. In accurate calculator operation.
Computing Earthwork Quantities (by hand) 1. Volumes from areas and mass ordinates 2. Determine final borrow quantities 3. Summarize earth volumes	2	Knowledge 1. Of basic mathematics--areas, volumes and arithmetic. 2. Of shrink and swell factors. 3. Of layout of earthwork computation sheet. 4. Of average end area volume computation method. Skill and Ability 1. In accurate calculator operation. 2. To use earthwork computation tables.
Plotting Mass Diagrams (by hand) 1. Plotting mass ordinances supplied by others	1	Knowledge 1. Of basic mathematics--arithmetic Skill and Ability 1. To print words and figures legibly. 2. To perform basic drafting--straight lines. 3. To determine applicable scale. 4. To recognize obvious errors in mass line configuration.

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR ROAD DESIGN ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Totaling Final Quantities 1. All other construction quantities 2. Preparing summary sheets	3	Knowledge 1. Of basic mathematics--arithmetic. 2. Of format and layout of contract plans and plan reading--symbols, and note location and format. 3. Of pay quantities. 4. Of standard drawing numbers. Skill and Ability 1. In calculator operation. 2. To prepare summaries according to accepted format.
Writing Preliminary Special Provisions 1. Developing statements for peculiar or non-standard situations	7	Knowledge 1. Of project development and history. 2. Of design standards, standard provisions and design policies. 3. Of construction practices and procedures, and of historical construction problems and change orders. 4. Of contract plans content. 5. Of writing and basic English--grammar. 6. Of traffic maintenance and resultant restrictions in construction sequence. 7. Of sources of data to develop alternatives and solutions. Skill and Ability 1. To recognize and visualize features of the project and effects of special provisions.
Inking Final Plans and Tracing	1	Knowledge 1. Of basic drafting practices including line weights. 2. Of plan reading--symbols, nomenclature and terminology. Skill and Ability 1. In drafting--legible work on tracing and inking. 2. To utilize and maintain drafting equipment.

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR ROAD DESIGN ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Coding Basic Computer Inputs 1. Develop transmittal sheets for desired runs 2. Code shrinkage factor, additional mass data, profile grade data, bridge ends, superelevation	2	Knowledge 1. Of coding sheet layout--columns and fields. 2. Of plan reading--profile line, vertical and horizontal curves and locations. Skill and Ability 1. To code legibly and accurately.
Coding Complex Computer Inputs 1. Earthwork including horizontal line 2. Offsets and projections 3. Area and geometric runs	6	Knowledge 1. Of coding sheet layouts. 2. Of nature and objective of output data. 3. Of plan reading--projected and staked levels and cross sections. 4. Of program limitations and characteristics. Skill and Ability 1. To code legibly and accurately.
Checking and Interpreting Computer Outputs	4	Knowledge 1. Of input data format. 2. Of nature and objective of output data and format. Skill and Ability 1. To visualize results of runs. 2. To determine reasonableness of answers.
Cross-Checking Structure and Road Plans 1. Review plans for alignment, grade, structure length and clearance correlation	3	Knowledge 1. Of reading and interpretation of road and bridge plans--lengths, vertical and horizontal alignments, grades and clearances.

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR ROAD DESIGN ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Extending Estimates and Quantities 1. Mathematical extensions	2	Knowledge 1. Format of forms and operation to be performed. 2. Basic mathematics--arithmetic. Skill and Ability 1. In accurate calculator operation.
Plotting Construction Limits 1. Cut and fill slopes, rounding, and inlet and outlet ditches	1	Knowledge 1. Of plan reading--stations and cross sections. 2. Of computer output data--catch limits Skill and Ability 1. To perform basic drafting legibly.
Preparing Right-of-Way Linens 1. Blotting out information on VanDyke prints	1	Knowledge 1. Of format of right-of-way plans. Skill and Ability 1. To perform the work legibly and accurately. 2. To blank out unnecessary construction plans information.
Preparing Right-of-Way Sepias 1. Developing 40 acre tracts	3	Knowledge 1. Of land subdivision--sections and nomenclature. Skill and Ability 1. To perform basic drafting--land lines.

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Interpreting and Plotting Property Lines 1. Deed information 2. Property lines	5	Knowledge 1. Of legal section subdivision--quarter and sixteenth corners, nomenclature. 2. Of metes and bounds descriptions--bearings and distances. 3. Of basic mathematics--proportions, conversions and areas--and highway trigonometry--functions and tables. Skill and Ability 1. To read and interpret land deeds. 2. To perform basic drafting--land lines. 3. To proportion record distances against actual measurements.
Designing Right-of-Way Limits 1. Based on construction limits 2. Record data on plans	4	Knowledge 1. Of right-of-way standards and practices--slope rounding and right-of-way break 2. Of general land values. 3. Of property limits, basics of deed writing and limit descriptions. Skill and Ability 1. To make decisions with regards to taking of small remainders of low land value.
Preparing Utility Plans 1. Plotting utility feature call-outs 2. Reviewing utility agreements 3. Revising plans to conform [illegible]reements	2	Knowledge 1. Of plan reading--topography and cross sections. 2. Of field notes--topography. 3. Of utility plan format layout and symbols. 4. Of practices for removing utilities within construction limits. Skill and Ability 1. To correct utility call-outs to construction centerline. 2. To perform basic drafting--straight lines.
[illegible]t Agreements	3	Skill and Ability 1. To read and interpret legal agreements including contract supplements. 2. To determine responsibilities of concerned parties.

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR ROAD DESIGN ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Checking and Reviewing Plans 1. Determination of accuracy and adequacy	7	Knowledge 1. Of plan reading--symbols, abbreviations, format, conversions and proportions. 2. Of basic mathematics--areas, conversions, proportions and volumes and highway trigonometry--functions, tables and curves. 3. Of design standards, policies, procedures, specifications and special provisions. 4. Of project history and development--interpretation of progress correspondence and design file. 5. Of computer output information format. 6. Of proper plan format--road design, traffic and surfacing. Skill and Ability 1. To design the work being checked.

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR SURFACING ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Determining Soil Support Value 1. Reviewing reports 2. Checking plan and profile sheets 3. Calculating soil support value	4	Knowledge 1. Of soils mechanics--classifications of soils, basic types of tests, and limitations and characteristics of common soils 2. Of plans reading--symbols, abbreviations and views 3. Of basic mathematics--arithmetic, ratios and conversions 4. Of applicable Department policy and derived from AASHO standards 5. Of basic geology--underlying clay seams 6. Of format of soils and geology report Skill and Ability 1. To interpret the results of tests 2. In accurate calculator operation
Designing Structural Sections 1. Developing alternate structural sections 2. Determining quantities 3. Comparing economic factors	5	Knowledge 1. Of limitations and properties of materials--lime, cement, asphalt and gravel 2. Of advantages and disadvantages of combinations of materials 3. Of AASHO guidelines--coefficients 4. Of Department policies and procedures on structural sections--thickness of wearing surface, of standard slopes, crown, etc. 5. Of basic mathematics--add, subtract and volumes 6. Of construction techniques and procedures related to the roadway surface 7. Of plan reading--symbols, abbreviation and views 8. Of compaction factors 9. Of unit price information--statewide average bid tabs, current average bid tabs and filed bid tabs 10. Of materials availability in state 11. Of geology of area--basic such as ranges of support values and weather conditions 12. Of traffic characteristics--ability to know when traffic counts are reasonable, and make-up of traffic. Skill and Ability 1. To compute average end areas 2. In accurate calculator operation

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR SURFACING ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Selecting Suitable Material Sources 1. Reviewing existing material source files 2. Determining availability of material sources	5	Knowledge 1. Of filing system for material source files 2. Of soils mechanics--soils classifications, limitations and characteristics of materials and basic testing 3. Of construction crushing techniques 4. Of Department policies and procedures related to material sources 5. Of basic mathematics--arithmetic 6. Of format of pit reports 7. Of standard specifications related to material sources Skill and Ability 1. To read and interpret pit reports
Determining Theoretical Crush-down 1. Determining gradations	2	Knowledge 1. Of testing procedures for gradation 2. Of formula for derivation of theoretical crush-down 3. Of sources of data for formula 4. Of standard specifications for gradation 5. Of format of theoretical crush-down form Skill and Ability 1. To apply formula to determine theoretical crush-down 2. In accurate calculator operation

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR OFFICE ENGINEERING ACTIVITIES

Work Activity	Level of Difficulty	Typical Knowledge, Skill and Ability Requirement
Developing Contract Bid Item List 1. Bid item lists 2. Coding item numbers 3. Project splits	5	Knowledge 1. Of form format 2. Of financial splits--type codes, funding, county, financial district, and highway system. 3. Of data sources--unit costs, plans, traffic control and safety, materials 4. Of unit costs--designers, files, Board of Review, indexing, market trends and previous bids. 5. Of computer outputs and inputs--layout format, numbers listings 6. Of basic mathematics--ratios and conversions 7. Of plans--error correction, logic check on quantities, format and content in general 8. Of work in other sections, project history, work flow and requirements of other agencies Ability 1. To compile various types of plans--signing, traffic, seeding, fencing, road etc.
Preparing Engineer's Estimate	3	Knowledge 1. Of basic mathematics--multiplication, division and ratios 2. Of Bureau of Public Roads submission requirements 3. Of sources of cost data 4. Of data processing output reports--bid item listing Ability 1. To determine invalid bid items--illogical quantity designations 2. To compare check lists and engineer's estimate. 3. To prepare estimate in proper format 4. To perform agreement and assignment checks

Work Activity	Level of Difficulty	Typical Knowledge, Skill and Ability Requirements
Preparing Modified Estimate	4	Knowledge 1. Of basic mathematics 2. Of B.P.R. requirements and procedures 3. Of sources of cost data 4. Of data processing output reports 5. Of change orders, work orders and progress estimates 6. Of sources of funds--federal-aid ratios, participating projects
Developing Standard City Agreements and County Resolutions	2	Knowledge 1. Of agreement requirements and applicable policies and procedures 2. Of agreement types--traffic and lighting 3. Of plan reading and interpretation, Department plans, city plats, etc. 4. Of B.P.R. Requirements and procedures 5. Of standard agreements Ability 1. To develop descriptions for inclusion in standard formats
Developing Special City Agreements and County Resolutions	7	Knowledge 1. Of agreement requirements and applicable policies and procedures 2. Of agreement types 3. Of plan reading and interpretation 4. Of B.P.R. requirements and procedures 5. Of standard agreements 6. Of proper legal formats Ability 1. To make determination of adequacy and need for legal review 2. To perform economic review to determine funding under applicable policies 3. To express the intent of the agreement in written form.

Work Activity	Level of Difficulty	Typical Knowledge, Skill and Ability Requirements
Writing Final Special Provisions	7	Knowledge 1. Of standard specifications, project history and correspondence 2. Of plan reading 3. Of preliminary special provision recommendations from final plan-in-hand, designers and materials 4. Of proper format, procedures and previous special provisions 5. Of intent of the provision, description of items covered, methods of construction and methods of measurement and payment 6. Of economic evaluations--alternate methods and public interest Ability 1. To prepare the special provision that can be understood in proper format
Preparing Proposal Package	3	Knowledge 1. Of standard documents, their uses and limitations 2. Of special provisions 3. Of contract plans 4. Of format and content 5. Of Bureau of Public Roads requirements and Department policies and procedures 6. Of bidder qualification requirements and documentation
Presenting Project to Board of Review 1. Project proposal 2. Unit prices 3. Plans and special provisions	7	Knowledge 1. Of all project factors--history, design, public hearings and correspondence 2. Of design standards, specifications, special provisions and project design Ability 1. To present project concept and approach
Preparation for Letting	3	Knowledge 1. Of requirements for advertising 2. Of resume for bids 3. Of prequalification procedure 4. Of cost per set of plans and cross-sections 5. Of plan changes--addenda, procedures and methods of communication

Work Activity	Level of Difficulty	Typical Knowledge, Skill and Ability Requirements
Conducting Bid Letting and Evaluating Bids	3	Knowledge 1. Of contract plans 2. Of bidding procedures 3. Of opening procedures--read and tabulate 4. Of bid checking--bid prices, omissions or errors, signatures, bonds and seals 5. Of Commission requirements Ability 1. To present findings
Compiling, Reviewing & Clearing Standard Drawings	4	Knowledge 1. Of functions of sections in preconstruction--hydraulics, traffic, bridge, surfacing and road design 2. Of need for changes and methods of performing changes and getting proper approvals--technical determinations by others.
Preparing Bid Summaries	2	Knowledge 1. Of award sheets--3 lowest bidders and actions taken 2. Of bid tabulations--extensions for all bidders 3. Of distribution lists 4. Of letting data 5. Of commission actions 6. Of computer printouts of work sheet summaries 7. Of standard forms Ability 1. To prepare the summary

WORK ACTIVITIES, KNOWLEDGE, SKILL AND ABILITY REQUIREMENTS AND LEVELS OF DIFFICULTY FOR GENERAL PRECONSTRUCTION ACTIVITIES

Work Activity	Level of Difficulty	Typical Knowledge, Skill and Ability Requirements
Preparing and Reviewing Correspondence	0	Knowledge 1. Of applicable Department and Preconstruction policies and procedures 2. Of basic formats and methods of business letterwriting 3. Of project development and history 4. Of applicable design standards, specifications and special provisions 5. Of project plan content and design decision criteria Ability 1. To communicate effectively 2. To visualize proposed changes 3. To evaluate the effects of proposed changes
Preparing or Reviewing Reports	7	Knowledge 1. Of the subject-at-hand--project or technical requirements 2. Of applicable policies, procedures, standards, specifications and special provisions 3. Of basic formats and methods of report preparation and presentation Ability 1. To communicate effectively
Technical Research	0	Knowledge 1. Of the fundamentals necessary to analyze, evaluate and apply the subject-at-hand Ability 1. To relate similar circumstances and apply desirable solutions

Work Activity	Level of Difficulty	Typical Knowledge, Skill and Ability Requirements
Giving or Receiving Supervision	0	Knowledge (for giving supervision) 1. Of the subject matter in detail 2. Of the standards, policies and procedures of the Department Ability 1. To be able to do the job being described Skill 1. In employee relations
Preparing Time and Leave Records	0	Knowledge 1. Of personnel policies and procedures 2. Of accounting policies and procedures 3. Of work performed
Preparing Progress Reports	5	Knowledge 1. Of project control forms. 2. Of project schedules 3. Of project progress to date 4. Of number of man days expended on the project
Handling Files, Supplies and Equipment	0	Knowledge 1. Of applicable procedures Skills 1. Required manual dexterity
Other Assignments Out of Area, Business Related	0	None
Out of Area, Purpose Unknown	0	None

Work Activity	Level of Difficulty	Typical Knowledge, Skill and Ability Requirements
Absent From Work	0	None
Personal Time	0	None
Waiting for Assignment	0	None
Business Related Telephone Calls	0	Variable as relates to individual work activities.

File under Phase I

MANPOWER UTILIZATION

TRAFFIC

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR TRAFFIC AND CONTROL DEVICES -- NON ELECTRICAL -- ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Determine layout for standard traffic control devices 1. Developing sketch of layout	2	Knowledge 1. Of pertinent portions of uniform traffic control devices and locations -- uniform manual, Montana sign index, standard drainage, pavement marking manual, special policies and motor vehicle code (rules of the road). 2. Of Department and FHWA policies and procedures related to traffic Skill and Ability 1. Very basic drafting -- create sketches
Determine layout and design for guide signs and unusual signing situations 1. Determining message of sign 2. Determining sign size -- "shop drawing" 3. Determining sign mounting -- ground or overhead 4. Developing sketch of layout for yields, 4-way stops, transitions, etc.	4	Knowledge 1. Of pertinent portions of uniform traffic control devices and locations -- uniform manual, Montana sign index, standard drawings, pavement marking manual, special policies and motor vehicle code (rules of the road). 2. Of principles of traffic engineering -- optimum flow criteria, human factors including reaction times and over-and-under signing, and economic evaluation of the type of installation and type of construction material. 3. Of Department and FHWA policies and procedures related to traffic Skill and Ability 1. To select the optimum physical feature alternative 2. Very basic drafting -- create sketches
Prepare guide sign plan sheet 1. Preparing drawing on plan sheet	1	Knowledge 1. Of symbols, abbreviations, sign layouts, and format of presentation 2. Of standard cut-outs Skill and Ability 1. To use and maintain drafting equipment and supplies

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR ELECTRICAL TRAFFIC CONTROL DEVICES ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Determine need for signalization and lighting 1. Analyzing traffic volumes, accident frequency, turning movements and traffic flow 2. Developing signal and/or lighting warrants	5	Knowledge 1. Of signalization and lighting warrant practices and policies and limitations in their usage 2. Of applicable traffic movements -- chart derived from traffic count 3. Of types of signals and lights 4. Of sources for traffic count data -- field studies and/or Planning and Survey Division 5. Of basic mathematics -- arithmetic Skill and Ability 1. To apply the standards as expressed in the warrants to the item and situation under study 2. To develop the warrant as justified
Develop signal and lighting layout in sketch form 1. Developing sketches for pedestrian crossings, lighting intensity, signal locations and signal types 2. Developing pole schedules	4	Knowledge 1. Of alternative types of signals and lights 2. Of location of data -- warrant 3. Of location of plan data -- city plats, utility plans, road plans, correspondence, and right of way plans 4. Of basic mathematics -- arithmetic -- and geometry -- radii 5. Of standards relating to placement of poles 6. Of standards of illumination -- intensity levels Skill and Ability 1. In basic drafting -- create sketch 2. To interpret illumination data and develop pole schedules 3. To develop pole locations considering maintenance, safety, esthetics and structural limitations.

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR ELECTRICAL TRAFFIC CONTROL DEVICES ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Develop wiring layout, conduit layout and size and wire size, number and layout	6	Knowledge 1. Of basic mathematics -- arithmetic, areas and formulae 2. Of Ohm's law 3. Of number and characteristics of facilities to be serviced 4. Of location and type of power source and agreements made for power service Skill and Ability 1. In electrical drafting -- schematics, diagrams, symbols, abbreviations 2. To relate Ohm's law to the selection of wire size and conduit size
Develop timing schedule	5	Knowledge 1. Of traffic flow for location -- characteristics of traffic and traffic movement 2. Of number of devices in system 3. Of traffic progression -- platoons, delay characteristics and safety requirements 4. Of characteristics and location of facilities to be controlled 5. Of intersection capacity -- lane width, pedestrian walks, parking and intersection width 6. Of characteristics of control equipment Skill and Ability 1. To interpret data and balance the system -- traffic and pedestrian flow 2. To develop progression diagrams -- timing offsets, intersection spacing, timing splits
Develop phase diagrams	4	Knowledge 1. Of traffic characteristics of location 2. Of basic mathematics -- addition and subtraction 3. Of intersection points of conflict 4. Of limitations of phasing alternatives Skill and Ability 1. In basic drafting -- straight and curved lines, and legible lettering 2. To interpret effects of phase diagram

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR GEOMETRICS AND INVESTIGATIONS ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Review approach permits 1. Investigating conditions 2. Recommending action 3. Preparing sketch design of alternatives	4	Knowledge 1. Of approach standards and policies 2. Of turning radii for various vehicles 3. Of expected traffic volumes and sight distance requirements 4. Of Design Application and Approach permit -- legal form -- format Skill and Ability 1. To make engineering judgments for situations which do not fit the standards 2. To make engineering judgments weighing alternatives with total awareness of factors affecting costs -- high traffic approaches, medians and turning lanes 3. To visualize traffic operations
Design traffic control facilities related to roadway geometrics 1. Designing guard rail, islands, curb and crash barriers; capacity analyses and intersection analyses for geometric design	5	Knowledge 1. Of the application of applicable design standards, policies and practices 2. Of basic mathematics -- arithmetic -- highway trigometry -- functions, curves and tables 3. Of traffic flow and geometrics -- turning movements, traffic patterns, movements and characteristics Skill and Ability 1. To make economic engineering judgments such as the balance -- importance -- of individual features 2. In basic drafting -- development of curves, straight lines, line weights and legible printing
Determine adequacy of current facility and need for improvement-office analyses 1. Reviewing field data 2. Utilizing terminal for data 3. Reviewing data processing reports 4. Reviewing accident reports	5	Knowledge 1. Of correspondence describing problems 2. Of standards, practices and policies relating to facilities 3. Of applicable warrant -- school crossing specifications, etc. 4. Of applicable formats, inputs and programs Skill and Ability 1. In public relations 2. To interpret results of field measurements--traffic counts, gap measurements, etc. 3. To apply statistical theory -- means, medians, skew, and bell curve 4. To communicate effectively

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR GEOMETRICS AND INVESTIGATIONS ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Prepare crash diagrams	2	Knowledge 1. Of location and format of accident data 2. Of format and symbolism of the crash diagram 3. Of as-built plan format 4. Of plan reading -- straight line diagram, symbols and abbreviations 5. Of city and county plat format 6. Of mile post system 7. Of basic mathematics -- addition Skill and Ability 1. To classify accidents -- rear-end, head-on, side swipe, etc. 2. To interpret accident reports 3. To sketch diagram of accident location
Code data processing inputs	1	Knowledge 1. Of format of coding forms -- fields and required information type 2. Of usage and limitations of applicable statistical program tapes Skill and Ability 1. To operate terminal -- basic manual operation and typing 2. To read format and symbols of paper tape
Prepare speed zone folder	2	Knowledge 1. Of requirements and format of folder content -- speed profile, historgram, computer printouts, cumulative percentile graphs, plan view (tracing or drawing), correspondence, and speed zone plats. 2. Of basic plan reading -- stationing, P.C. and P.T. points, grade 3. Of applicable speed zone number 4. Of speed zone terminology -- no theory -- 85 percentile, upper and lower limit of pace. Skill and Ability 1. In basic drafting -- straight and curved lines, line weights, symbols, abbreviations and legible printing

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR GEOMETRICS AND INVESTIGATIONS ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Operate remote terminal	1	Knowledge 1. Of coding sheet layouts 2. Of general nature and objective of output data 3. Of input limitations and criteria Skill and Ability 1. To type

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR GENERAL ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Prepare title sheet and summary sheet	1	Knowledge 1. Of format of sheets 2. Of project information to be included on sheet 3. Of sources of data and supplies 4. Of procedures involved with development of sheet 5. Of development of project splits 6. Of basic mathematics -- addition and subtraction Skill and Ability 1. In basic drafting -- straight lines and line weights 2. To use Leroy and Verigraph equipment 3. To maintain drafting equipment 4. To interpret project limits for program documents
Prepare or check quantity sheet 1. Utilizing sign erection and location sheet, etc. 2. Developing post lengths	3	Knowledge 1. Of signing standard drawings -- information and format 2. Of material take-off forms available in traffic 3. Of basic mathematics -- counting, arithmetic 4. Of principles and practices related to project splits 5. Of general format of bid items in Office Engineers - method of payment and measurement 6. Of format of the quantity sheet 7. Of plan reading -- symbols, abbreviations and stationing Skill and Ability 1. In basic drafting -- straight lines, line weights and legible lettering 2. To identify and note special situations -- non-standard sign legends, and construction problems 3. In accurate calculator operation

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR GENERAL ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Prepare preliminary special provisions--non-electrical 1. Determining material type, construction methods, method of measurement and payment for all applications other than signals and lighting	5	Knowledge 1. Of signing design standard provisions and signing policies 2. Of project development and history 3. Of construction practices and procedures, and of historical construction problems and change orders 4. Of signing plans content 5. Of writing and basic English--grammar 6. Of traffic maintenance and resultant restrictions in construction sequence 7. Of sources of data to develop alternatives and solutions Skill and Ability 1. To recognize and visualize features of the project and effects of special provisions
Prepare preliminary special provisions--electrical 1. Determining materials types, construction methods, methods of measurement and payment for all signal and lighting applications	6	Knowledge 1. Of standard provisions and policies covering signals and lights 2. Of project development and history 3. Of construction practices and procedures--problems and change orders 4. Of lighting and signal plans content 5. Of the basic usage of English language and correct grammar 6. Of traffic maintenance and flow 7. Of alternative solutions Skill and Ability 1. In recognizing the need for and developing realistic and feasible special provisions

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR GENERAL ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Participate in field inspections 1. Participating in plan-in-hand and final inspections, field reviews, location public hearings, and design public hearings	5	Knowledge 1. Of specifications, design standards and special provisions 2. Of traffic signing plans in detail--content of plans and design decision criteria 3. Of project history 4. Of policies--relating to traffic Skill and Ability 1. In effective Department and public relations 2. To evaluate the effects of proposed changes--design policies, schedules and engineering economics 3. To communicate effectively 4. To visualize plans and changes
Check design plans--non-electrical 1. Reviewing plan information to determine adequacy and accuracy for sign and geometric plans	5	Knowledge 1. Of plan reading--symbols, abbreviations, format, conversions and proportions 2. Of basic mathematics--areas, conversions, proportions and volumes--highway trigonometry--functions, tables and curves--highway geometry--shapes and areas 3. Of traffic standards, policies, procedures, specifications and special provisions 4. Of project history and development--interpretation of progress correspondence and design file 5. Of proper plan format--road design, traffic and surfacing Skill and Ability 1. To design the work being checked
Check design plans--electrical 1. Reviewing plan information to determine adequacy and accuracy of signs and lighting plans	6	Knowledge 1. Of plan reading--symbols, abbreviations, format, conversions and proportions 2. Of basic mathematics--areas, conversions, proportions and volumes--highway trigonometry--functions, tables and curves--highway geometry--shapes and areas 3. Of traffic standards, policies, procedures, specifications and special provisions 4. Of project history and development--interpretation of progress correspondence and design file 5. Of proper plan format--road design, traffic and surfacing Skill and Ability 1. To design the work being checked

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR GENERAL ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Prepare or check the design of signing, lighting and signal structure	6	Knowledge 1. Of basic structural engineering--statics (moments and loads) and strength of materials--formulae, and principles 2. Of characteristics of materials--steel, aluminum and concrete 3. Of appropriate standards and policies--deflection criteria, heights and sizes 4. Of weather characteristics--wind, storm severity, etc. 5. Of basic mathematics--arithmetic--algebra and trigonometry Skill and Ability 1. In basic drafting--sketching, symbols, abbreviations and straight line work 2. In accurate calculator operation and/or slide rule operation
Develop cost estimates	3	Knowledge 1. Of location of bid price information--published data 2. Of percent increase to be applied to the published data 3. Of format of cost estimate sheet 4. Of terminology of bid item 5. Of basic mathematics--multiplication and addition Skill and Ability 1. To ascertain the validity of the average bid price--based on the number of items reported for the previous period 2. In accurate calculator operation 3. To make engineering judgments in selecting bid prices for non-standard items and peculiar situations
Prepare plan view of roadway 1. Developing information from existing plans, aerial surveys, survey notes or field inspections	1	Knowledge 1. Of basic plan reading--stationing, symbols, abbreviations and types of views 2. Of items to be included on the plan view--centerline, stations, equations, and P.C. and P.T. points Skill and Ability 1. In basic drafting--inking, straight lines, line weights and legible printing 2. To maintain drafting equipment 3. To lay out plans in desired format

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR GENERAL ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Plot data from sketch layout	2	Knowledge 1. Of basic drafting practices including line weights 2. Of plan reading--symbols, nomenclature and terminology Skill and Ability 1. In drafting--legible work on tracing and inking 2. To utilize and maintain drafting equipment
Prepare or review reports 1. Developing plan-in-hand reports, etc.	5	Knowledge 1. Of the subject-at-hand--project or technical requirements 2. Of applicable policies, procedures, standards, specifications and special provisions 3. Of basic formats and methods of report preparation and presentation Ability 1. To communicate effectively
Prepare progress reports	4	Knowledge 1. Of project control forms 2. Of project schedules 3. Of project progress to date 4. Of number of man days expended on the project
Prepare or review correspondence 1. Requesting information by letter or memorandum	0	Knowledge 1. Of applicable Department and Preconstruction policies and procedures 2. Of basic formats and methods of business letterwriting 3. Of project development and history 4. Of applicable design standards, specifications and special provisions 5. Of project plan content and design decision criteria Ability 1. To communicate effectively 2. To visualize proposed changes 3. To evaluate the effects of proposed changes

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR GENERAL ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
Technical research 1. Referring to standard plans, manufacturer's brochures, etc. 2. Searching plans or correspondence for data	0	Knowledge 1. Of the fundamentals necessary to analyze, evaluate and apply the subject-at-hand Ability 1. To relate similar circumstances and apply desirable solutions
Give or receive supervision 1. Giving assignments 2. Checking project progress 3. Training such as demonstrating procedures	0	Knowledge (for giving supervision) 1. Of the subject matter in detail 2. Of the standards, policies and procedures of the Department Ability 1. To be able to do the job being described Skill 1. In employee relations
Prepare time and leave records	0	Knowledge 1. Of personnel policies and procedures 2. Of accounting policies and procedures 3. Of work performed
Handle files, supplies and equipment	0	Knowledge 1. Of applicable procedures Skills 1. Required manual dexterity
Other assignments out-of-area, business related 1. Attending meetings, seminars, etc. with other divisions related to a project (do not include field trips)	0	None

WORK ACTIVITIES
KNOWLEDGE, SKILL AND ABILITY (KSA) REQUIREMENTS
AND LEVELS OF DIFFICULTY
FOR GENERAL ACTIVITIES

WORK ACTIVITY	LEVEL OF DIFFICULTY	TYPICAL KNOWLEDGE, SKILL AND ABILITY STATEMENTS
2. Discussing problem areas 3. Attending safety meetings orientation meeting, etc. 4. Field trips for special studies and inventories		
Business related telephone calls	0	Variable as relates to individual work activities
Out-of-area, purpose unknown	0	None
Personal time 1. Taking breaks, personal telephone calls, reading the newspaper, etc.	0	None
Waiting for assignment	0	None
Absent from work	0	None
No observation taken	0	None

December 10, 1970

MEMORANDUM

TO: Jack R. Beckert
Grover O. Powers
William Dunbar
Design Management Committee

FROM: Ed Shaw, Roy Jorgensen Associates

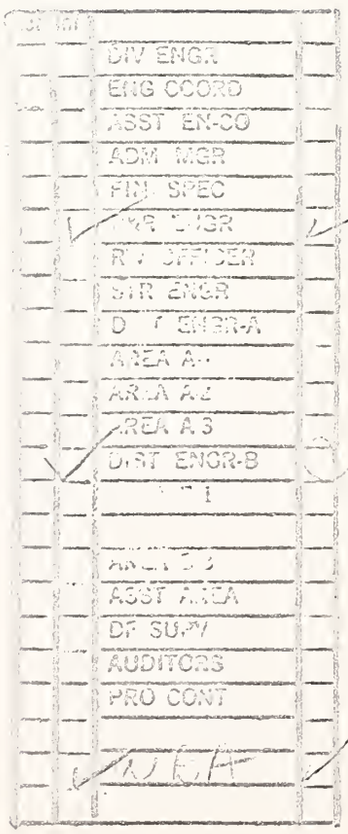
SUBJECT: Correction of Manpower Inventory and Turnover Analysis

Enclosed are corrected copies of the subject data.

You will note that the manpower inventory continues to exclude administrative and clerical personnel, however, we are enclosing the tables which complete the total inventory.

The period of the turnover analysis was from January 1968 through July 1970, as shown in our data transmitted with the September 1 progress report. Our presentation data erroneously showed the period of analysis to be January 1968 through July 1969.

We regret these errors.



MANPOWER INVENTORY
PRECONSTRUCTION DIVISION
DISTRIBUTION OF EMPLOYEES
BY PERSONNEL CLASSIFICATION

August, 1970

PERSONNEL CLASSIFICATION	NUMBER OF EMPLOYEES	PERCENT OF GROUP	GROUP PERCENT OF TOTAL
ENGINEERS: *			
Major Section Heads and Above (G-26 to G-32)	10	31%	
Assistant Section Heads (G-24)	6	19	
Designer III (G-23)	4	12	
Designer II and Comparable (G-21)	5	16	
Engineer-In-Training (G-19)	7	22	
	32	100%	20%
TECHNICIANS:			
Designer III and Above (G-23 to G-24)	16	14%	
Designer II and Comparable (G-21)	12	11	
Estimates Supervisor II (G-20)	2	2	
Designer I (G-19)	14	12	
Detailer II and Plotter II (G-19)	3	3	
Detailer I (G-17)	15	13	
Estimates Supervisor I (G-17)	2	2	
Draftsman III and Plotter I (G-15)	24	21	
Draftsman II (G-13)	23	21	
Draftsman I (G-11)	1	1	
Subtotal -- Technicians	112	100%	71
ADMINISTRATIVE AND CLERICAL	14		9
TOTAL -- Preconstruction Division	158		100%

RATIO OF TECHNICIANS TO ENGINEERS 3.6 to 1
RATIO WITHOUT ENGINEERS-IN-TRAINING 4.5 to 1

*For purpose of this analysis Engineers are defined as graduates in directly related engineering curriculum and those with E. I. T. status or Professional Engineering license.

DISTRIBUTION OF PRECONSTRUCTION EMPLOYEES
BY SECTION
August, 1970

Section	--- TOTAL --- Number	Percent	-NUMBER OF EMPLOYEES- Engineers	Technicians And Others	Ratio of Technicians To Engineers
Road Design:					
East Region	35	22%	4	31	7.8 to 1
West Region *	40	25	10	30	3.0 to 1 *
Tracing	6	4	--	6	---
Surfacing Design	4	3	1	3	2.0 to 1
Consultant Design	9	6	2	7	3.5 to 1
Subtotal	94	59%	17	77	4.0 to 1
Traffic Engineering	22	14	5	17	3.4 to 1
Office Engineering	11	7	2	9	3.5 to 1
Hydraulics	6	4	4	2	1.0 to 2
Stereo Section	3	2	--	3	---
Administration & Supporting	16	10	4	12	1.3 to 1
Subtotal	152	96	32	120	3.4 to 1
Field Design (Full-time)	6	4	--	6	
TOTAL	158	100%	32	126	3.6 to 1
Percent of Total	100%		20%	80%	

* Ratio of Technicians to Engineers Excluding Engineers-in-Training is 6.0 to 1

DISTRIBUTION OF PERSONNEL BY AGE *

August 1970

Age Groups	Engineers		Technicians		Total	
	Number	Percent Of Total	Number	Percent Of Total	Number	Percent Of Total
20 to 40 years old	22	69%	71	63%	93	65%
41 to 55 years old	6	19	32	29	38	26
56 to 60 years old	1	3	4	4	5	3
Over 60 years old	3	9	5	4	8	6
Total	32	100%	112	100%	144	100%
Average Age	37		38		38	

* - Excludes non-engineering administrative and clerical personnel, and field design personnel.

DISTRIBUTION OF PERSONNEL BY YEARS OF EDUCATION *

August 1970

Grouped Years of Education	Engineers		Technicians		Total	
	Number	Percent Of Total	Number	Percent Of Total	Number	Percent Of Total
Less than 12 years			6	5%	6	4%
12 years	2	6%	49	44	51	36
13 to 15 years			41	36	41	28
16 years	25	78	12	11	37	26
More than 16 years	5	16	4	4	9	6
Total	32	100%	112	100%	144	100%
Average Years of Education	16		13		14	

* - Excludes non-engineering administrative and clerical personnel, and field design personnel.

DISTRIBUTION OF PERSONNEL BY YEARS OF DEPARTMENT EXPERIENCE *

August 1970

Grouped Years of Department Experience	Engineers		Technicians		Total	
	Number	Percent Of Total	Number	Percent Of Total	Number	Percent Of Total
Less than 1 year	5	16%	3	3%	8	5%
1 to 5 years	13	41	40	36	53	37
6 to 15 years	8	25	41	36	49	34
16 to 25 years	2	6	25	22	27	19
Over 25 years	4	12	3	3	7	5
Total	32	100%	112	100%	144	100%
Average Years Experience	18		10			

* - Excludes non-engineering administrative and clerical personnel and field design personnel.

DISTRIBUTION OF ADMINISTRATIVE AND CLERICAL PERSONNEL BY AGE
August 1970

Personnel Classification	Number of Employees: Total	20 to 40 Years	41 to 55 Years	56 to 60 Years	Over 60 Years	Average Age
Office Manager, Secretary I and Clerk III (G-20 and 12)	3	1	1		1	49
Clerk II and Steno II (G-10)	3	1	1	1		43
Steno I and Clerk I (G-8)	6	3	2	1		39
Clerk Typist II (G-6)	2	2				21
Total--Clerical	14	7	4	2	1	39
Percent Distribution	100	50	29	14	7	
Average Age	39	25	49	56	64	

DISTRIBUTION OF ADMINISTRATIVE AND CLERICAL PERSONNEL BY YEARS OF EDUCATION
August 1970

Personnel Classification	Total	12 Years	13 to 15 Years	Average Years Of Education
Office Manager, Secretary I and Clerk III (G-20 and 12)	3	2	1	12
Clerk II and Steno II (G-10)	3	2	1	13
Steno I and Clerk I (G-8)	6	4	2	12
Clerk-Typist II (G-6)	2	1	1	13
Total -- Clerical	14	9	5	12
Percent Distribution	100	64	36	
Average Years of Education	12	12	14	

DISTRIBUTION OF ADMINISTRATIVE AND CLERICAL PERSONNEL BY YEARS OF DEPARTMENT EXPERIENCE
August 1970

Personnel Classification	Total	Less Than 1 Year	1 to 5 Years	6 to 15 Years	Average Years Experience
Office Manager, Secretary I and Clerk III (G-20 and 12)	3		1	2	9
Clerk II and Steno II (G-10)	3	1	2		1
Steno I and Clerk I (G-8)	6		6		2
Clerk Typist II (G-6)	2	1	1		1
Total--Clerical	14	2	10	2	3
Percent Distribution	100	14	72	14	
Average Years Experience	3		2	12	

PRECONSTRUCTION TURNOVER ANALYSIS
BY SECTION
January 1968 Through July 1970

	TOTAL TERMINATIONS			PERMANENT PERSONNEL TERMINATIONS		
	Period Total Number	Average Annual Number	Average Annual Rate	Period Total Number	Average Annual Number	Average Annual Rate
ENGINEERS:						
Assistant Section Heads and Above (G-24 up)	5	2.0	13%	5	2.0	13%
Specl I Assignment Engineer II	1	0.4	10	--	--	--
Designer II	1	0.4	8	1	0.4	8
Designer I	3	1.2	*	3	1.2	*
Engineer-In-Training	2	0.8	11	1	0.4	6
Subtotal-Engineers	12	4.8	15	10	4.0	13
TECHNICIANS:						
Designer I	1	0.4	3	1	0.4	3
Detailer I	5	2.0	13	5	2.0	13
Draftsman III	5	2.0	8	5	2.0	8
Draftsman II	16	6.4	28	9	3.6	16
Draftsman I	10	4.0	400	--	--	--
Subtotal-Technicians	37	14.8	15	20	8.0	7
OTHERS:	26	10.4	74	3	1.2	9
Total -- Preconstruction	75	30.0	19%	33	13.2	8%

* There are no engineers currently employed in this classification

PRECONSTRUCTION TURNOVER ANALYSIS
BY SECTION
January 1968 Through July 1970

	---TOTAL TERMINATIONS---			PERMANENT PERSONNEL TERMINATIONS		
	Period Total Number	Average Annual Number	Average Annual Rate	Period Total Number	Average Annual Number	Average Annual Rate
General Administration *	8	3.2	13%	3	1.2	5%
Office Engineering	1	0.4	9	--	--	--
West Region	11	4.4	28	7	2.8	7
East Region	12	4.8	31	7	2.8	7
Hydraulics	8	3.2	53	6	2.4	25
Traffic	31	12.4	56	9	3.6	16
Public Hearings	3	1.2	24	--	--	--
Consultant Design	1	0.4	4	1	0.4	4
Total	75	30.0	19%	33	13.2	8%

*Includes Tracing and stereo

Note: Rates are an annual average rate over the $2\frac{1}{2}$ year period of the analysis.

CURRENT STATUS REVIEW

STATUS OF CONTRACT PLAN PREPARATION
PROJECTS SCHEDULED FOR ADVERTISEMENT
AUGUST, 1970 THROUGH JUNE, 1971

Month Scheduled	No. of Projects	Range in Percent Completion	Average Percent Completion
1970:			
August	10	45% to 100%	82%
September	25	0 to 100	82
October	23	0 to 98	70
November	13	0 to 100	31
December	6	0 to 61	26
1971:			
January	10	0 to 98	35
February	4	0 to 5	3
March	11	0 to 90	56
April	11	0 to 91	37
May	15	0 to 90	33
June	7	0 to 90	39
Total	135	0% to 100%	
Weighted Average			55%

Source: Semi-monthly Report of Status of Projects for Proposed Future Lettings dated July 5, 1970

STATUS OF CONSTRUCTION PLANS PREPARATION
DISTRIBUTION OF PROJECTS
BY PERCENT OF DESIGN COMPLETED

July 5, 1970

MONTH SCHEDULED FOR ADVERTISEMENT	PERCENT DESIGN COMPLETED JULY 5, 1970							
	0%	1% to 25%	26% to 50%	51% to 75%	76% to 95%	96% to 99%	100%	Total
August:								
Number of Projects			2	1	4		3	10
Percent of Projects			20%	10%	40%		30%	100%
September:								
Number of Projects	1	2	2	2	9	4	5	25
Percent of Projects	4%	8%	8%	8%	36%	16%	20%	100%
October:								
Number of Projects	3		3	2	14	1		23
Percent of Projects	13%		13%	9%	61%	4%		100%
November:								
Number of Projects	4	3	1	3	1		1	13
Percent of Projects	30%	23%	8%	23%	8%		8%	100%
December:								
Number of Projects	2	2	1	1				6
Percent of Projects	33%	33%	17%	17%				100%
January:								
Number of Projects	4	2	1		2	1		10
Percent of Projects	40%	20%	10%		20%	10%		100%
Six Month Total:								
Number of Projects	14	9	10	9	30	6	9	87
Percent of Projects	16%	11%	11%	11%	34%	7%	10%	100%

STATUS OF ROAD DESIGN PROJECTS
BY SYSTEM AND MONTH
JULY, 1970 THROUGH JUNE, 1971

Month Advertisement Scheduled	INTERSTATE				PRIMARY AND SECONDARY			
	Department Design		Consultant Design		Department Design		Consultant Design	
	No. of Projects	Average % Complete	No. of Projects	Average % Complete	No. of Projects	Average % Complete	No. of Projects	Average % Complete
1970:								
July	1	100%	4	100%	14	100%	--	--
August	--	--	--	--	2	68	--	--
September	3	89	1	90	5	97	1	100%
October	2	70	6	79	6	89	--	--
November	1	75	--	--	4	67	--	--
December	1	61	--	--	1	50	--	--
1971:								
January	2	25	--	--	2	88	--	--
February	--	--	--	--	--	--	--	--
March	2	78	--	--	7	65	--	--
April	2	71	2	49	5	34	--	--
May	3	77	1	90	3	0	--	--
June	--	--	--	--	4	68	--	--
Total	17		14		53		1	
Weighted Average		72%		82%		74%		100%

Source: Semi-Monthly Report of Status of Projects for Interstate Section Letter, Dated July 5, 1970

STATUS OF CONSTRUCTION DESIGN
FOR SELECTED SAMPLE OF ACCELERATED PROJECTS

January through August 1970

PROJECT TYPE	LENGTH	ADVERTISEMENT DATE Schedule	ADVERTISEMENT DATE Actual	Months Accelerated	PERCENT COMPLETED Three Months Before Advertisement	PERCENT COMPLETED One Month Before Advertisement
G, GS, PMS	3.0 miles	7-71	8-70	11	95% *	100% 2/
G, GS, PMS, Str.	7.0 miles	4-71	8-70	8	95%	100% 1/
G, GS, PMS, Str.	5.1 miles	9-71	7-70	14	90%	100% 1/
GS, PMS, Str.	9.2 miles	11-71	6-70	17	80%	95% 1/
GS, PMS	11.4 miles	1-71	4-70	8	90%	98% 1/
G	0.8 mile	8-71	3-70	17	90% **	90% 2/
GS, PMS	0.8 mile	7-72	3-70	28	90% **	90% 2/
G, GS, PMS, Str.	0.5 mile	11-72	3-70	32	***	100% 2/

* Not reported. Status of design two months prior to advertisement was 95%.
** Not reported. Status of design two months prior to advertisement was 90%.
*** Not reported.
1/ Design by Consultants.
2/ Design by Department.

Sources: Scheduled advertisement dates from Tentative Construction Program 1970-1974.
Percent construction design completed from Semi-Monthly Report of Status of Projects For Future Lettings.

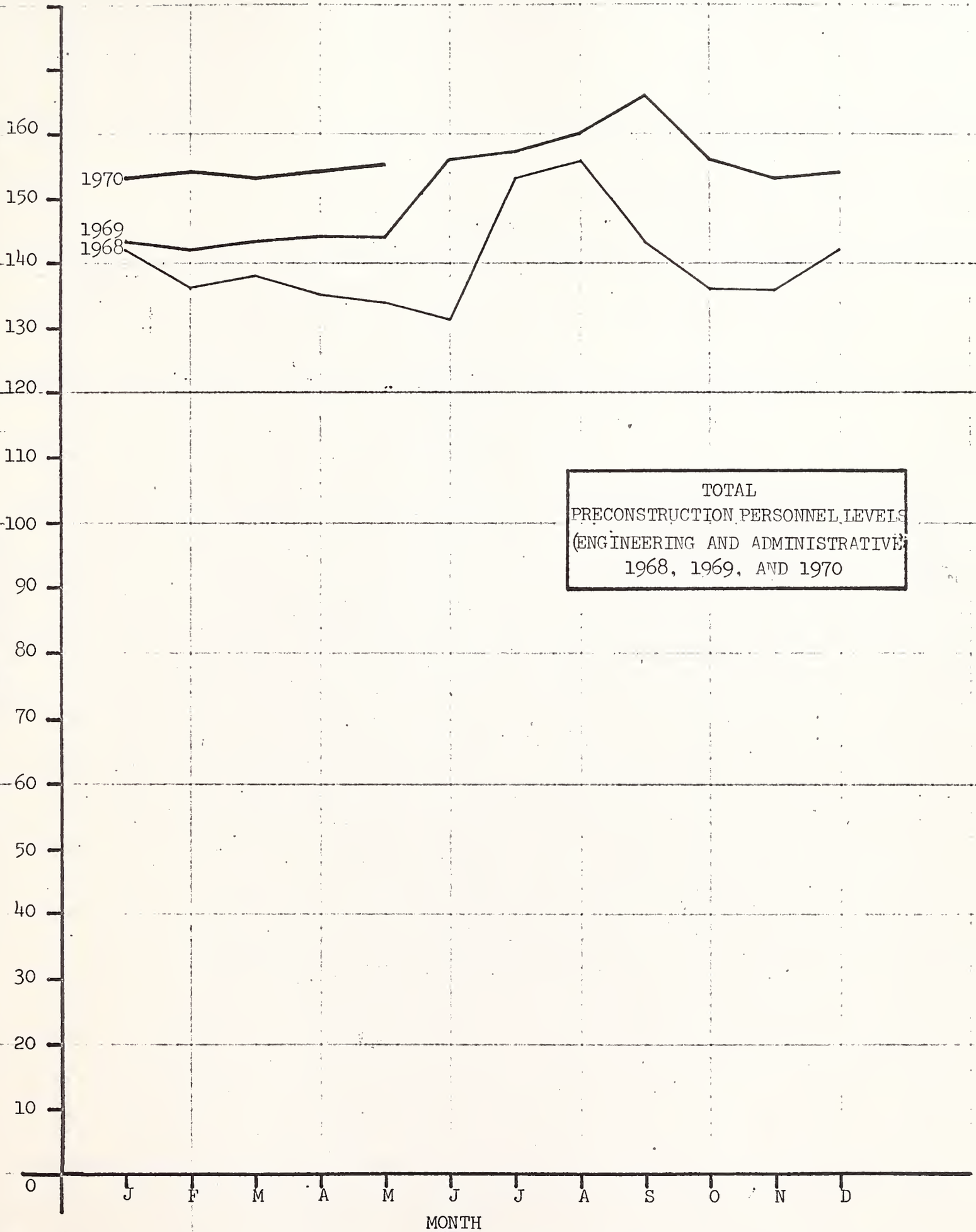
STATUS OF CONSTRUCTION DESIGN
FOR SELECTED SAMPLE OF DELAYED PROJECTS

January through August 1970

PROJECT TYPE	LENGTH OF PROJECT	ADVERTISEMENT DATE Scheduled	ADVERTISEMENT DATE Actual or (Reschedule)	ADVERTISEMENT DATE Months Delay	PERCENT COMPLETED One Month Before Schedule Date	PERCENT COMPLETED Schedule Date
G, GS, PMB	5.5 miles	7-70	(9-70)	2	98%	98%
G, GS, PMB	5.5 miles	7-70	(10-70)	(3)	95%	95%
G, GS, PMS	9.3 miles	3-70	6-70	3	98%	99%
G, GS, PMB	8.0 miles	7-70	(10-70)	(3)	70%	90%
G, GS, PMB	7.8 miles	7-70	(1-71)	(6)	90%	95%
G, GS, PMB	9.0 miles	7-70	(11-70)	(4)	90%	90%
G, GS, Br.	8.0 miles	7-70	(7-71)	(12)	35%	35%
G, GS, PMS	8.3 miles	6-70	(9-70)	(3)	98%	98%
G, Str., F	11.4 miles	3-70	(1-71)	(10)	90%	98%
G, GS, PMS, Str.	13.5 miles	3-70	8-70	5	92%	95%
G, GS, PMS, Strs.	9.0 miles	2-70	3-70	1	98%	100%
PMS, Str.	12.2 miles	7-70	8-70	1	86%	100%
G, GS	13.0 miles	4-70	9-70	5	98%	98%
AVERAGES	9.3 miles			4	88%	92%

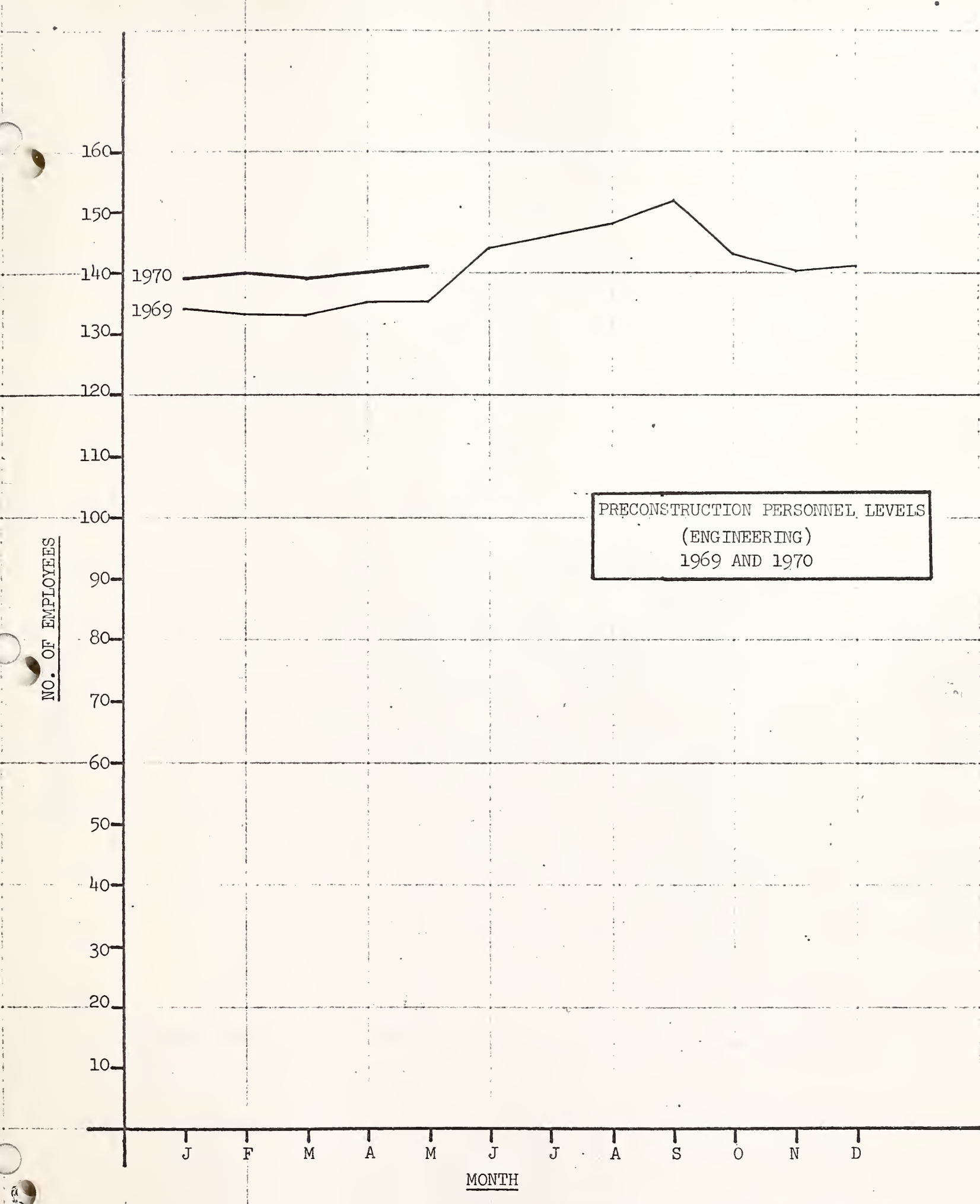
Sources: Scheduled advertisement dates from Montana Highway Commission Tentative Construction Program 1970-1974.
Percent construction design completed from Semi-Monthly Report of Status of Projects for Future Lettings.

MANPOWER INVENTORY



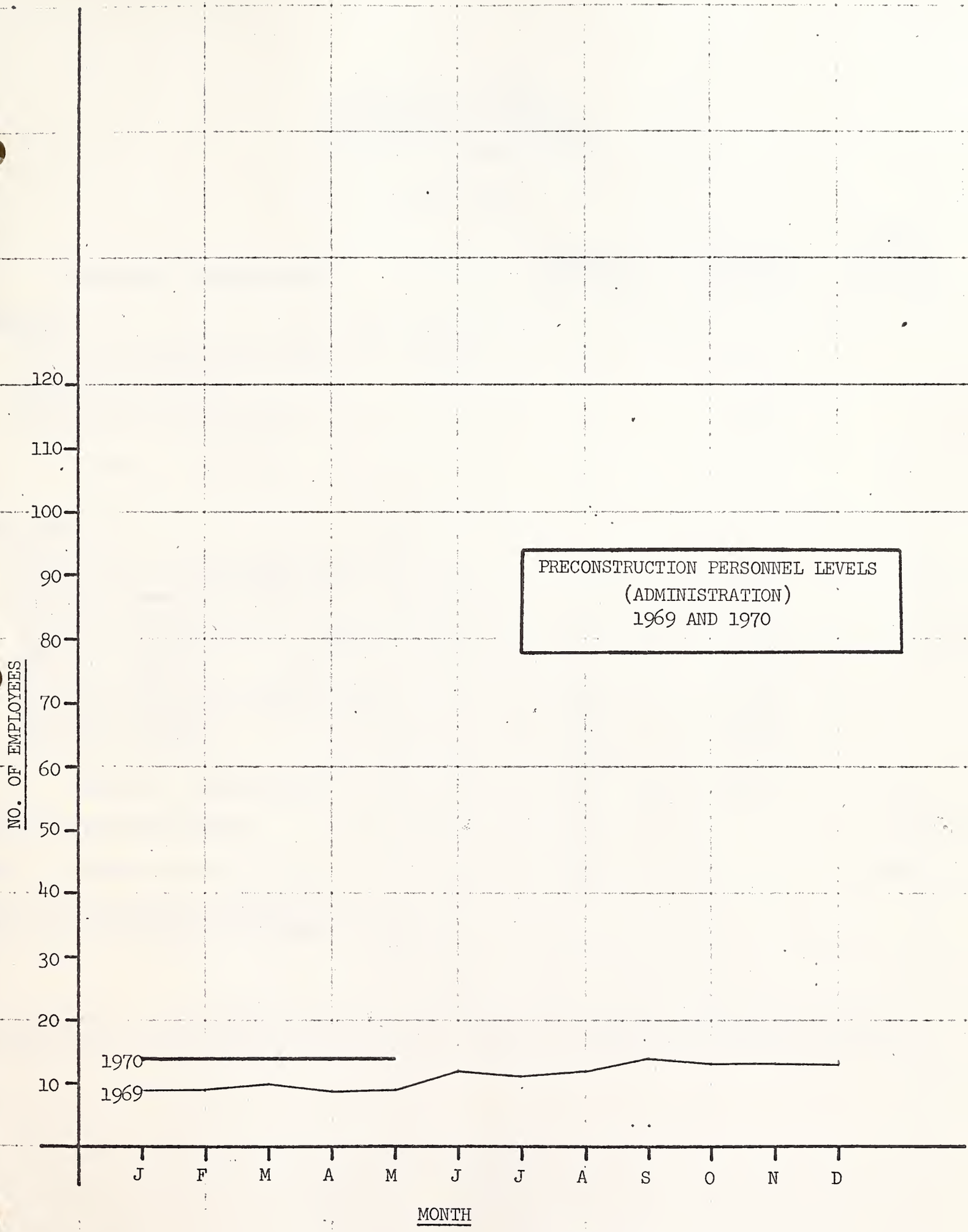
TOTAL
PRECONSTRUCTION PERSONNEL LEVELS
(ENGINEERING AND ADMINISTRATIVE)
1968, 1969, AND 1970

SOURCE: PERSONNEL AND SALARY
COMPARISON REPORT



PRECONSTRUCTION PERSONNEL LEVELS
(ENGINEERING)
1969 AND 1970

SOURCE: PERSONNEL AND SALARY COMPARISON REPORT



SOURCE: PERSONNEL AND SALARY COMPARISON REPORT

MANPOWER INVENTORY
PRECONSTRUCTION DIVISION
DISTRIBUTION OF EMPLOYEES
BY PERSONNEL CLASSIFICATION

August 1970

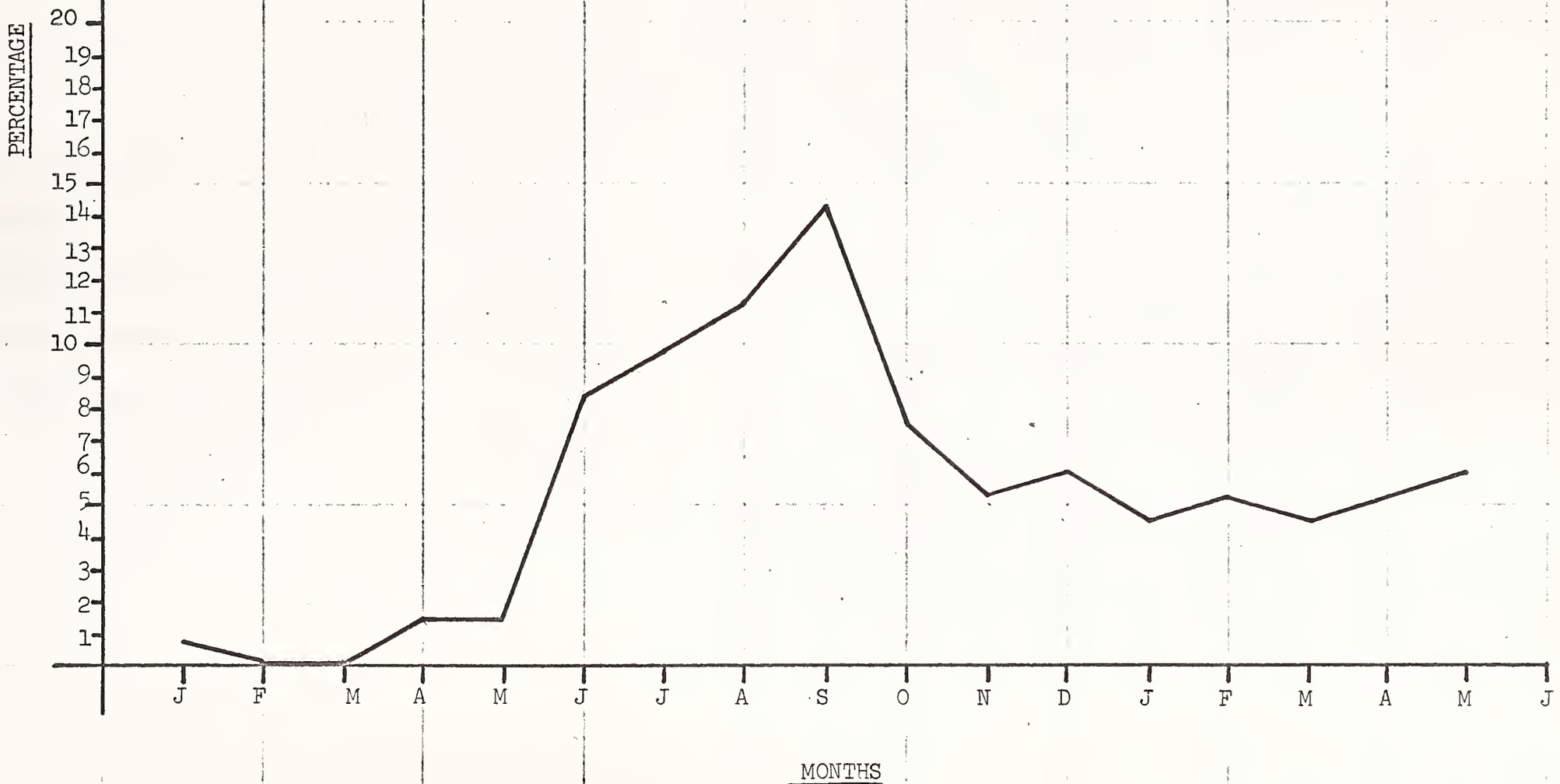
PERSONNEL CLASSIFICATION	NUMBER OF EMPLOYEES	PERCENT OF GROUP	GROUP PERCENT OF TOTAL
ENGINEERS:*			
Major Section Heads and Above (G-26 to G-32)	10	31%	
Assistant Section Heads (G-24)	6	19%	
Designer III (G-23)	4	12%	
Designer II and Comparable (G-21)	5	16%	
Engineer-In-Training (G-19)	7	22%	
Subtotal -- Engineers	32	100%	20%
TECHNICIANS:			
Designer III and Above (G-23 to G-24)	16	14%	
Designer II and Comparable (G-21)	12	11%	
Estimates Supervisor II (G-20)	2	2%	
Designer I (G-19)	14	12%	
Detailer II and Plotter II (G-19)	3	3%	
Detailer I (G-17)	15	13%	
Estimates Supervisor I (G-17)	2	2%	
Draftsman III and Plotter I (G-15)	24	21%	
Draftsman II (G-13)	23	21%	
Draftsman I (G-11)	1	1%	
Subtotal -- Technicians	112	100%	71%
ADMINISTRATIVE AND CLERICAL	14		9%
TOTAL -- Preconstruction Division	158		100%

RATIO OF TECHNICIANS TO ENGINEERS 3.5 to 1
RATIO WITHOUT ENGINEERS-IN-TRAINING 4.5 to 1

* For purpose of this analysis Engineers are defined as graduates in directly related engineering curriculum and those with E. I. T. status or Professional Engineering license.

PRECONSTRUCTION DIVISION
PERCENTAGE INCREASE IN
ENGINEERING STAFF
1969-1970

BASE PERIOD EMPLOYMENT LEVEL = 133 ENGINEERS
SEPT. 1969 PEAK EMPLOYMENT LEVEL = 152 ENGINEERS



DISTRIBUTION OF ENGINEERS
BY AGE
August 1970

Personnel Classification	Number of Employees					
	Total	20 to 40 Years Old	41 to 55 Years Old	56 to 60 Years Old	Over 60 Years Old	Average Age
Section Heads and Above (G-26 to 32)	10	4	3	1	2	48
Asst. Section Heads (G-24)	6	5	1		1	36
Designer III (G-23)	4	1	2		1	48
Designer II and Comparable (G-21)	5	5				31
Engineer-In-Training (G-19)	7	7				25
Total--Engineers	32	22	6	1	3	37
Percent Distribution	100%	69	19	3	9	
Average Age	37	30	51	58	63	

DISTRIBUTION OF ENGINEERS BY YEARS OF EDUCATION
August 1970

Personnel Classification	Number of Employees: Total	12 Years	16 Years	17 Years Or More	Average Years Education
Section Heads and Above (G-26 to 32)	10	2	7	1	15
Asst. Section Heads (G-24)	6		5	1	16
Designer III (G-23)	4		4		16
Designer II and Comparable (G-21)	5		5		16
Engineer-in-Training (G-19)	7		4	3	16
Total--Engineers	32	2	25	5	16
Percent Distribution	100%	6	78	16	
Average Years Education	16	12	16	17	

Manpower Inventory
Precon[illegible]ruction Division

DISTRIBUTION OF ENGINEERS
BY YEARS OF DEPARTMENT EXPERIENCE
August 1970

Personnel Classification	Number of Employees: Total	Less Than 1 Year	1 to 5 Years	6 to 15 Years	16 to 25 Years	Over 25 Years	Average Years Experience
Section Heads and Above (G-26 to 32)	10		1	5	1	3	18
Asst. Section Heads (G-24)	6		4	1	1		7
Designer III (G-23)	4		2	1		1	11
Designer II and Comparable (G-21)	5		4	1			5
Engineer-In-Training (G-19)	7	5	2				*
Total--Engineers	32	5	13	8	2	4	9
Percent Distribution	100	16	41	25	6	12	
Average Years Experience	9		3	11	24	37	

* Less than one year.

DISTRIBUTION OF ENGINEERS
BY YEARS OF NON-DEPARTMENT EXPERIENCE
RELATED TO CURRENT ASSIGNMENTS
August, 1970

Personnel Classification	Number of Employees: Total	Less Than 1 Year	1 to 5 Years	6 to 15 Years	16 to 25 Years	Average Years Experience
Section Heads and Above (G-26 to 32)	10	2	6		2	5
Asst. Section Heads (G-24)	6	3	3			2
Designer III (G-23)	4	2		1	1	7
Designer II and Comparable (G-21)	5	3	2			1
Engineer-In-Training (G-19)	7	6	1			1
Total -- Engineers	32	16	12	1	3	3
Percent Distribution	100%	50	38	3	9	
Average Years Experience	3	0	3	6	18	

DISTRIBUTION OF TECHNICIANS
BY AGE
August 1970

Personnel Classification	Number of Employees: Total	20 to 40 Years Old	41 to 55 Years Old	56 to 60 Years Old	Over 60 Years Old	Average Age
Designer III and Above (G-23 and 24)	16	6	9	1		44
Designer II and Estimates Supervisor II (G-20 and 21)	14	6	6	1	1	44
Designer I and Comparable (G-19)	17	11	4	1	1	42
Detailer I and Estimates Supervisor I (G-17)	17	10	7			37
Draftsman III and Plotter I (G-15)	23	13	6	1	3	41
Draftsman II and I (G-13 and 11)	24	24				22
Total--Technicians	111	70	32	4	5	38
Percent Distribution	100	63	29	4	4	
Average Age	38	29	48	58	63	

DISTRIBUTION OF TECHNICIANS BY YEARS OF EDUCATION
August 1970

Personnel Classification	NUMBER OF EMPLOYEES: Total	Less Than 12 Years	12 Years	13 to 15 Years	16 Years	More Than 16 Years	Average Years Of Education
Designer III and Above (G-23 and 24)	16	2	7	6	1		12
Designer II and Estimates Supervisor II (G-20 and 21)	14	2	8	1	1	2	13
Designer I and Comparable (G-19)	17	1	9	4	3		13
Detailer I and Estimates Supervisor I (G-17)	17		6	6	5		14
Draftsman III and Plotter I (G-15)	23	1	9	11	1	1	13
Draftsman II and I (G-13 and 11)	24		10	12	1	1	13
Total -- Technicians	111	6	49	40	12	4	13
Percent Distribution	100	5	44	36	11	4	
Average Years of Education	13	9	12	14	16	17	

Manpower Inventory
Precon uction Division

DISTRIBUTION OF TECHNICIANS
BY YEARS OF DEPARTMENT EXPERIENCE
August 1970

Personnel Classification	NUMBER OF EMPLOYEES						Average Years Of Experience
	Total	Less Than 1 Year	1 to 5 Years	6 to 15 Years	16 to 25 Years	Over 25 Years	
Designer III and Above (G-23 and 24)	16		1	2	13		18
Designer II and Estimates Supervisor II (G-20 and 21)	14			8	5	1	17
Designer I and Comparable (G-19)	17		2	13	2		12
Detailer I and Estimates Supervisor I (G-17)	17		5	8	3	1	9
Draftsman III and Plotter I (G-15)	23		12	8	2	1	9
Draftsman II and I (G-13 and 11)	24	3	20	1			
Total -- Technicians	111	3	40	40	25	3	10
Percent Distribution	100	3	36	36	22	3	
Average Years of Experience	10	10	2	12	21	29	

Manpower Inventory
Preconstruction Division

DISTRIBUTION OF TECHNICIANS
BY YEARS OF NON-DEPARTMENT EXPERIENCE
RELATED TO CURRENT ASSIGNMENTS
August 1970

Personnel Classification	Number of Employees: Total	Less Than 1 Year	1 to 5 Years	6 to 15 Years	16 to 25 Years	Average Years Experience
Designer III and Above (G-23 and 24)	16	11	1	3	1	3
Designer II and Estimates Supervisor II (G-20 and 21)	14	9	4	1		2
Designer I and Comparable (G-19)	17	9	3	2	3	4
Detailer I and Estimates Supervisor I (G-17)	17	4	7	5	1	5
Draftsman III and Plotter I (G-15)	23	15	4	3	1	2
Draftsman II and I (G-13 and 11)	24	11	13			1
Total -- Technicians	111	59	32	14	6	3
Percent Distribution	100	53	29	13	5	
Average Years Experience	3		2	9	19	

DISTRIBUTION OF ADMINISTRATIVE AND CLERICAL PERSONNEL BY AGE
August 1970

Personnel Classification	Number of Employees: Total	20 to 40 Years	41 to 55 Years	56 to 60 Years	Over 60 Years	Average Age
Office Manager, Secretary I and Clerk III (G-20 and 12)	3	1	1		1	49
Clerk II and Steno II (G-10)	3	1	1	1		43
Steno I and Clerk I (G-8)	6	3	2	1		39
Clerk Typist II (G-6)	2	2				21
Total--Clerical	14	7	4	2	1	39
Percent Distribution	100	50	29	14	7	
Average Age	39	25	49	56	64	

DISTRIBUTION OF ADMINISTRATIVE AND CLERICAL PERSONNEL BY YEARS OF EDUCATION
August 1970

Personnel Classification	Total	12 Years	13 to 15 Years	Average Years Of Education
Office Manager, Secretary I and Clerk III (G-20 and 12)	3	2	1	12
Clerk II and Steno II (G-10)	3	2	1	13
Steno I and Clerk I (G-8)	6	4	2	12
Clerk-Typist II (G-6)	2	1	1	13
Total -- Clerical	14	9	5	12
Percent Distribution	100	64	36	
Average Years of Education	12	12	14	

DISTRIBUTION OF ADMINISTRATIVE AND CLERICAL PERSONNEL BY YEARS OF DEPARTMENT EXPERIENCE
August 1970

Personnel Classification	Total	Less Than 1 Year	1 to 5 Years	6 to 15 Years	Average Years Experience
Office Manager, Secretary I and Clerk III (G-20 and 12)	3		1	2	9
Clerk II and Steno II (G-10)	3	1	2		1
Steno I and Clerk I (G-8)	6		6		2
Clerk Typist II (G-6)	2	1	1		1
Total--Clerical	14	2	10	2	3
Percent Distribution	100	14	72	14	
Average Years Experience	3		2	12	

MANPOWER INVENTORY
FULL-TIME FIELD DESIGN PERSONNEL
DISTRIBUTION OF EMPLOYEES
BY PERSONNEL CLASSIFICATION

August 1970

Personnel Classification	Number of Employees
BILLINGS:	
TECHNICIANS:	
Designer II (G-21)	1
Detailer II (G-19)	1
Draftsman III (G-15)	1
Subtotal -- Billings	3
GREAT FALLS:	
TECHNICIANS:	
Designer II (G-21)	1
Detailer II (G-19)	1
Draftsman III (G-15)	1
Subtotal -- Great Falls	3
TOTAL -- Field Design	6

DISTRIBUTION OF FIELD DESIGN TECHNICIANS
BY AGE
March 1970

Personnel Classification	Number of Employees — Total	20 to 40 Years Old	41 to 55 Years Old	Over 60 Years Old	Average Age
Designer II (G-21)	2		1	1	59
Detailer II (G-19)	2	1	1		38
Draftsman III (G-15)	2	1	1		42
Total--Field Design	6	2	3	1	46
Average Age	46	37	49	64	

DISTRIBUTION OF FIELD DESIGN TECHNICIANS
BY YEARS OF EDUCATION
August 1970

Personnel Classification	Total	12 Years	Average Years Education
Designer II (G-21)	2	2	12
Detailer II (G-19)	2	2	12
Draftsman III (G-15)	2	2	12
Total--Field Design	6	6	12

DISTRIBUTION OF FIELD DESIGN TECHNICIANS
BY YEARS OF DEPARTMENT EXPERIENCE
August 1970

Personnel Classification	Total	6 to 15 Years	16 to 25 Years	Over 25 Years	Average Years Experience
Designer (G-21)	2			2	29
Detailer II (G-19)	2	1	1		14
Draftsman III (G-15)	2	2			8
Total--Field Design	6	3	1	2	17

MANPOWER INVENTORY
ADMINISTRATIVE AND SUPPORTING GROUP*
DISTRIBUTION OF EMPLOYEES
BY PERSONNEL CLASSIFICATION
August, 1970

Personnel Classification	Number of Employees
ENGINEERS:	
Preconstruction Engineer (G-32)	1
Field Design Engineer (G-28)	1
Assistant Preconstruction Engineer (G-26)	1
Subtotal -- Engineers	3
TECHNICIANS:	
Special Assignments Engineer II (G-23)	1
Draftsman III (G-15)	1
Draftsman II (G-13)	1
Subtotal -- Technicians	3
ADMINISTRATIVE AND CLERICAL:	
Office Manager (G-20)	1
Secretary I (G-12)	1
Clerk II (G-10)	2
Clerk I (G-8)	1
Steno I (G-8)	2
Clerk-Typist II (G-6)	2
Subtotal -- Clerical	9
Total -- Administrative Group	15

* Excludes Secondary Roads

MANPOWER INVENTORY

CONSULTANT DESIGN SECTION

DISTRIBUTION OF EMPLOYEES
BY PERSONNEL CLASSIFICATION

August 1970

PERSONNEL CLASSIFICATION	NUMBER OF EMPLOYEES	GROUP PERCENT OF TOTAL
Engineers:		
Consultant Design Engineer (G-26)	1	
Engineer-In-Training (G-19)	1	
Subtotal - Engineers	2	22%
Technicians:		
Designer III (G-23)	3	
Designer I (G-19)	4	
Subtotal - Technicians	7	78%
TOTAL - Consultant Design Section	9	100%

MANPOWER INVENTORY

EAST REGION

DISTRIBUTION OF EMPLOYEES
BY PERSONNEL CLASSIFICATION

August 1970

PERSONNEL CLASSIFICATION	NUMBER OF EMPLOYEES	PERCENT OF GROUP	GROUP PERCENT OF TOTAL
Engineers:			
Regional Engineer (G-28)	1		
Area Engineer (G-24)	2		
Special Assignments Engineer I (G-21)	1		
Subtotal - Engineers	4		14%
Technicians:			
Designer III (G-23)	6	19%	
Designer II (G-21)	3	10%	
Designer I (G-19)	5	16%	
Detailer I (G-17)	4	13%	
Draftsman III (G-15)	7	23%	
Draftsman II (G-13)	6	10%	
Subtotal - Technicians	31	100%	86%
TOTAL - East Region	35		100%

RATIO OF TECHNICIANS TO ENGINEERS 7 to 1

MANPOWER INVENTORY

HYDRAULICS SECTION

DISTRIBUTION OF EMPLOYEES
BY PERSONNEL CLASSIFICATION

August 1970

PERSONNEL CLASSIFICATION	NUMBER OF EMPLOYEES
Engineers:	
Hydraulics Engineer (G-28)	1
Designer III (G-23)	1
Designer II (G-21)	1
Engineer-In-Training (G-19)	1
Subtotal - Engineers	4
Technicians:	
Detailer I (G-17)	1
Draftsman II (G-13)	1
Subtotal - Technicians	2
TOTAL - Hydraulics Section	6

RATIO OF TECHNICIANS TO ENGINEERS 1 to 2

MANPOWER INVENTORY
OFFICE ENGINEERING SECTION
DISTRIBUTION OF EMPLOYEES
BY PERSONNEL CLASSIFICATION
August, 1970

Personnel Classification	Number of Employees	Group Percent of Total
ENGINEERS:		
Office Engineer (G-28)	1	
Estimates Supervisor III (G-21)	1	
Subtotal -- Engineers	2	18%
TECHNICIANS:		
Estimates Supervisor IV (G-23)	1	
Designer II (G-21)	1	
Estimates Supervisor II (G-20)	2	
Estimates Supervisor I (G-17)	2	
Draftsman III (G-15)	1	
Subtotal -- Technicians	7	64
CLERICAL:		
Steno I (G-8)	2	18
Total -- Office Engineering Section	11	100%

MANPOWER INVENTORY
STEREO SECTION
DISTRIBUTION OF EMPLOYEES
BY PERSONNEL CLASSIFICATION
August 1970

Personnel Classification	Number of Employees
TECHNICIANS:	
Photogrammetric Chief (G-21)	1
Stereo Plotter Operator II (G-19)	1
Stereo Plotter Operator I (G-15)	1
Total -- Stereo Section	3

MANPOWER INVENTORY
SURFACING DESIGN SECTION
DISTRIBUTION OF EMPLOYEES
BY PERSONNEL CLASSIFICATION
August 1970

Personnel Classification	Number of Employees
ENGINEER:	
Surfacing Design Engineer (G-24)	1
TECHNICIANS:	
Designer II (G-21)	1
Designer I (G-19)	1
CLERICAL:	
Clerk III (G-12)	1
Total -- Surfacing Design Section	4

MANPOWER INVENTORY
COMPLETED PROJECT PLANS AND TRACING SECTION
DISTRIBUTION OF EMPLOYEES
BY PERSONNEL CLASSIFICATION
August, 1970

Personnel Classification	Number of Employees
TECHNICIANS:	
Detailer II (G-19)	1
Draftsman III (G-15)	2
Draftsman II (G-13)	2
Draftsman I (G-11)	1
Total -- Tracing Section	6

MANPOWER INVENTORY
TRAFFIC ENGINEERING SECTION
DISTRIBUTION OF EMPLOYEES
BY PERSONNEL CLASSIFICATION
August, 1970

Personnel Classification	Number of Employees	Percent of Group	Group Percent of Total
ENGINEERS:			
Traffic Engineer (G-28)	1		
Assistant Traffic Engineer (G-24)	1		
Designer III (G-23)	2		
Designer II (G-21)	1		
Subtotal -- Engineers	5		23%
TECHNICIANS:			
Designer I (G-19)	2	12%	
Detailer II (G-19)	1	6	
Detailer I (G-17)	4	24	
Draftsman III (G-15)	5	29	
Draftsman II (G-13)	5	29	
Subtotal -- Technicians	17	100%	77
Total -- Traffic Engineering Section	22		100%

RATIO OF TECHNICIANS TO ENGINEER 3.4 to 1

MANPOWER INVENTORY

WEST REGION

DISTRIBUTION OF EMPLOYEES
BY PERSONNEL CLASSIFICATION

August 1970

PERSONNEL CLASSIFICATION	NUMBER OF EMPLOYEES	PERCENT OF GROUP	GROUP PERCENT OF TOTAL
Engineers:			
Regional Engineer (G-28)	1		
Area Engineer (G-24)	2		
Designer III (G-23)	1		
Designer II (G-21)	1		
Engineer-In-Training (G-19)	5		
Subtotal - Engineers	10		25%
Technicians:			
Designer III (G-23)	4	13%	
Designer II (G-21)	5	17%	
Designer I (G-19)	2	7%	
Detailer I (G-17)	5	17%	
Draftsman III (G-15)	7	23%	
Draftsman II (G-13)	7	23%	
Subtotal - Technicians	30	100%	75%
TOTAL - West Region	40		100%

RATIO OF TECHNICIANS TO ENGINEERS 3 to 1

ANNUAL TERMINATIONS BY

TERMINATION REASON

JANUARY 1968 THROUGH JULY 1970

TERMINATION	YEAR 1968	1969	1970 Through July	Total *
Voluntary:				
1. Personal	2	1		3
2. School	9	14	5	28
3. Other Employment	8	9	5	22
Subtotal	19	24	10	53
Involuntary:				
1. Force Cut			1	1
2. Temporary Employment	9			9
3. For Cause	1			1
4. Deceased	1			1
5. Military Service	3	3	2	8
6. Retirement				0
7. Illness		2		2
Subtotal	14	5	3	22
Total	33	29	13	75

* Includes Permanent, Temporary and Probationary Personnel

Source: Special Computer Printout

TERMINATION DATA

JANUARY 1968 THROUGH JULY 1970

ITEM	ORGANIZATION								
	Preconstruction Gen. Admin.	Office Eng.	West Region	East Region	Hydraulics	Traffic	Public Hearings	Consultant Design	Total Number *
Total Number of Personnel Terminated by Organization	8	1	11	12	8	31	3	1	75
Terminations by Personnel Type and Organization:									
1. Permanent Personnel	3		7	7	6	9		1	33
2. Temporary Personnel	1	1	1		1	17	1		22
3. Probationary Personnel	4		3	5	1	5	2		20
Terminations by Termination Category:									
1. Voluntary Terminations **	4	1	7	9	7	21	3	1	53
2. Involuntary Terminations ***	4		4	3	1	10			22

* Includes Permanent, Temporary and Probationary Personnel.
** Voluntary Terminations include terminations for Personal, School and Other Employment Reasons.
*** Involuntary Terminations include terminations for Force Cut, Temporary Employment, For Cause, Deceased, Military Service, Retirement and Illness Reasons.

Source: Special Computer Printout

PERSONNEL TERMINATIONS

BY ORGANIZATION AND CLASSIFICATION

JANUARY 1968 THROUGH JULY 1970

CLASSIFICATION TITLE	ORGANIZATION: Preconstruction Gen. Admin.	Office Eng.	West Region	East Region	Hydraulics	Traffic	Public Hearings	Consultant Design	Total Number *
Engineering:									
Consultant Design Eng.								1	1
Assistant Traffic Eng.						1			1
Area Engineer				2					2
Special Assignment Engineer II	1								1
Surfacing Design Supr.				1					1
Engineer in Training				1	1				2
Technical:									
Designer III					1				1
Designer II	1			1	1				3
Designer I						1			1
Detailer I			2		2	1			5
Draftsman III			1		1	3			5
Draftsman II			4	4	2	6			16
Draftsman I	1		3	3		2	1		10
Clerical and Others:									
Agronomist			1						1
Stenographer I	2						1		3
Clerk Typist II	2	1					1		4
Clerk I	1					17			18
Total	8	1	11	12	8	31	3	1	75

* Includes Permanent, Temporary and Probationary Personnel

Source: Special Computer Printout

TERMINATIONS OF PERMANENT PERSONNEL

BY ORGANIZATION AND CLASSIFICATION

JANUARY 1968 THROUGH JULY 1970

CLASSIFICATION TITLE	ORGANIZATION: Preconstruction Gen. Admin.	Office Eng.	West Region	East Region	Hydraulics	Traffic	Public Hearings	Consultant Design	Total Number
Engineering:									
Consultant Design Eng.								1	1
Assistant Traffic Eng.						1			1
Area Engineer				2					2
Surfacing Design Eng.				1					1
Engineer in Training				1					1
Technical:									
Designer III					1				1
Designer II	1			1	1				3
Designer I						1			1
Detailer I			2		2	1			5
Draftsman III			1		1	3			5
Draftsman II			3	2	1	3			9
Clerical and Others:									
Agronomist			1						1
Stenographer I	1								1
Clerk I	1								1
Total	3	0	7	7	6	9	0	1	33

Source: Special Computer Printout

VOLUNTARY TERMINATIONS OF PERMANENT PERSONNEL

BY AGE AND CLASSIFICATION

JANUARY 1968 THROUGH JULY 1970

OCCUPATION TITLE	Total Number	--- AGE DISTRIBUTION ------ ----Range----- Low	High	Weighted Average
Engineering:				
1. Consultant Design Engineer	1	36	36	36
2. Assistant Traffic Engineer	1	31	31	31
3. Area Engineer	2	27	29	28
4. Surfacing Design Supervisor	1	38	38	38
5. Engineer in Training	1	25	25	25
Subtotal	6			
Weighted Average				31
Technical:				
1. Designer III	1	27	27	27
2. Designer II	3	24	26	25
3. Designer I	1	34	34	34
4. Detailer I	5	25	32	27
5. Draftsman III	5	24	28	26
6. Draftsman II	6	24	36	28
Subtotal	21			
Weighted Average				27
TOTAL	27			
TOTAL WEIGHTED AVERAGE				28

VOLUNTARY TERMINATIONS OF PERMANENT PERSONNEL

BY DEPARTMENT EXPERIENCE AND CLASSIFICATION

JANUARY 1968 THROUGH JULY 1970

OCCUPATION TITLE	Total Number	--- YEARS OF EXPERIENCE --- ----Range----- Low	High	Weighted Average
Engineering:				
1. Consultant Design Engineer	1	8	8	8
2. Assistant Traffic Engineer	1	5	5	5
3. Area Engineer	2	5	6	6
4. Surfacing Design Supervisor	1	3	3	3
5. Engineer in Training	1	2	2	2
Subtotal	6			
Weighted Average				5
Technical:				
1. Designer III	1	4	4	4
2. Designer II	3	2	3	2
3. Designer I	1	12	12	12
4. Detailer I	5	2	12	7
5. Draftsman III	5	1	3	2
6. Draftsman II	6	1	2	2
Subtotal	21			
Weighted Average				4
TOTAL	27			
TOTAL WEIGHTED AVERAGE				4

VOLUNTARY TERMINATIONS OF PERMANENT PERSONNEL

BY EDUCATION AND CLASSIFICATION

JANUARY 1968 THROUGH JULY 1970

OCCUPATION TITLE	Total Number	--- YEARS OF EDUCATION --- ----Range----- Low	High	Weighted Average
Engineering:				
1. Consultant Design Engineer	1	16	16	16
2. Assistant Traffic Engineer	1	17	17	17
3. Area Engineer	2	15	17	16
4. Surfacing Design Supervisor	1	16	16	16
5. Engineer in Training	1	17	17	17
Subtotal	6			
Weighted Average				16
Technical:				
1. Designer III	1	17	17	17
2. Designer II	3	16	18	17
3. Designer I	1	14	14	14
4. Detailer I	5	12	14	13
5. Draftsman III	5	10	17	14
6. Draftsman II	6	11	14	13
Subtotal	21			
Weighted Average				14
TOTAL	27			
TOTAL WEIGHTED AVERAGE				15

VOLUNTARY TERMINATIONS OF PERMANENT PERSONNEL

BY EDUCATION LEVEL AND CLASSIFICATION

JANUARY 1968 THROUGH JULY 1970

OCCUPATION TITLE	Total Number	HIGHEST LEVEL ATTAINED: Less Than High School	High School Graduate	College Graduate	Graduate Engineer
Engineering:					
1. Consultant Design Engineer	1			1	1
2. Assistant Traffic Engineer	1			1	1
3. Area Engineer	2			2	2
4. Surfacing Design Supervisor	1			1	1
5. Engineer in Training	1			1	1
Subtotal	6	0	0	6	6
Technical:					
1. Designer III	1			1	1
2. Designer II	3			3	3
3. Designer I	1		1		
4. Detailer I	5		5		
5. Draftsman III	5	1	2	2	
6. Draftsman II	6	1	5		
Subtotal	21	2	13	6	4
TOTAL	27	2	13	12	10

PHASE II

Approval: _____

Mr. Lewis M. Chittim, P. E., State Highway Engineer

POLICY

STANDARD DRAWINGS AND STANDARD SHEETS --

DEVELOPMENT AND UTILIZATION

POLICY: Standard Drawings will be developed and utilized to illustrate details of construction and materials which are uniformly incorporated in the design of construction projects.

The State Highway Commission will utilize Standard Drawings only for those work items and materials which:

1. Occur frequently enough throughout the year to warrant a master detail in order to reduce the considerable amounts of detailing and drafting effort required if drawn individually for each project, and

2. Can be defined and illustrated in ways clearly understandable for uniform application on all projects.

Standard Drawings for road construction, signing and lighting construction and bridge construction will be inserted in the detail section of the contract plans.

The State Highway Commission will utilize Standard Sheets only for those details of construction and materials which serve principally as guides and criteria for project design. Standard Sheets will be utilized by Commission personnel in the development of contract plan design and will not be distributed to contractors or material suppliers except as individual details in the contract plans.

Uniform title blocks will be established clearly identifying the sheet as a Standard Drawing or Standard Sheet, with provisions for signatures and revision dates.

The content and format of all Standard Drawings and Standard Sheets utilized by Commission personnel will be reviewed annually to ensure conformance with this policy.

SCOPE: This policy applies to all design projects let after January 1, 1972 and will be implemented as feasible on projects let prior to that date.

This statement of policy is made in order to assure consistency in design and construction and to minimize detailing and drafting work effort for individual projects.

RESPONSIBILITY:

The State Highway Engineer will ensure that all Standard Drawings and Standard Sheets utilized by the Commission are consistent with good engineering practices and Montana statutory requirements. He will approve all Standard Drawings and Standard Sheets and subsequent revisions thereto.

The Preconstruction Engineer will ensure that all Standard Drawings and Standard Sheets related to road construction and signing and lighting construction are developed, revised and distributed according to the guidelines of this policy. He will review annually the content of all Standard Drawings and Standard Sheets for which he is responsible.

The Bridge Engineer will ensure that all Standard Drawings related to bridge construction are developed, revised and distributed according to the guidelines of this policy. He will review annually the content of all Standard Drawings for which he is responsible.

PROCEDURE

STANDARD DRAWINGS AND STANDARD SHEETS--DEVELOPMENT AND UTILIZATION

AUTHORITY: This procedure has been prepared by the Preconstruction Engineer and approved by the State Highway Engineer in accordance with the Commission's policy on Standard Drawings and Standard Sheets--Development and Utilization.

PURPOSE: To establish the procedures for the development, review, approval and revision of Standard Drawings and Standard Sheets utilized by the Montana State Highway Commission.

PROCEDURE:

Responsibility	Action
Section Heads or Region Engineers	1. Determine the need for a standard which meets one of the following; a. Standard Drawing -- The subject matter (1) occurs frequently enough throughout the year to warrant a master detail in order to reduce the considerable amounts of detailing and drafting effort required if drawn individually for each project, and (2) can be defined and illustrated in ways clearly understandable for uniform application on all projects. b. Standard Sheet -- The subject matter serves principally as guides and criteria for project design. 2. Determine that the need does not meet the above criteria and that it is preferable to incorporate specific details in the plans for individual projects. 3. Prepare a preliminary definition of the scope of the standard including, but not limited to the following: a. A statement of the objective to be realized. b. A rough sketch of the proposed standard. c. A definition of specific problems to be resolved.

Responsibility	Action
Section Heads or Region Engineers	4. Insure that the proposed standard is adequate according to good engineering practice and meets the Federal Highway Administration's requirements and Montana legal requirements.
	5. Transmit the preliminary data to the Office Engineer and requests the development of the standard.
Office Engineer	6. Reviews the recommendation and preliminary information.
	7. Determines the priority for the development of the standard.
Office Engineer and Standard Drawings Supervisor	8. Determine the need for specialized data such as hydraulics, traffic, materials, bridge or construction information.
	9. Develop a schedule for the development of the standard.
Standard Drawings Supervisor	10. Requests the specialized data or special studies from the appropriate source.
	11. Receives the required information to develop the standard.
	12. Completes the development of the standard in pencil.
Office Engineer and Standard Drawings Supervisor	13. Transmits the preliminary standard to the Preconstruction Engineer.
Preconstruction Engineer	14. Reviews the preliminary standard for adequacy.
	15. Requests additional information or modifications.
Standard Drawings Supervisor	16. Obtains the additional information or completes the modifications as requested.
Office Engineer	17. Obtains the approval of the standard content from the State Highway Engineer.
	18. Transmits the standard to the Federal Highway Administration and requests approval.

Responsibility	Action
Office Engineer	19. Receives approval of the standard from the Federal Highway Administration.
	20. Notifies the Preconstruction Engineer of the State Highway Engineer's and the Federal Highway Administration's approval.
Standard Drawings Supervisor	21. Completes the final development and inking of the standard.
Preconstruction Engineer	22. Approves the distribution of the standard according to the following: a. Standard Drawing -- distributed (1) to all recipients of the Field and Office Standards and the Design Manual for reference purposes, and (2) to contractors, suppliers and department personnel attached as a part of the contract plans for which the Standard Drawing applies. b. Standard Sheet -- distributed to all recipients of the Field and Office Standards and the Design Manual for reference purposes.
Office Engineer	23. Accomplishes the distribution according to the above criteria.
Preconstruction Engineer	24. Requests reviews and reports annually from Preconstruction Section Heads and Region Engineers, as well as the Construction Engineer and District Engineers to ascertain the adequacy and accuracy of the standards.
	25. Requests the Office Engineer to modify the existing standards as needed.
Office Engineer and Standard Drawings Supervisor	26. Complete the modification of the standards as requested.

Requests from other divisions which originate throughout the year should be directed to the Preconstruction Engineer for his appropriate action. Requests should be accompanied by (1) a statement of the objective to be realized, (2) a rough sketch of the proposal, and (3) a definition of specific problems to be resolved.

REVIEW OF STANDARD DRAWINGS

STANDARD NUMBER	NAME OF STANDARD	STANDARD DRAWING	STANDARD SHEET	OTHER
06-01	Gravel Pit Markers		x	
06-10	Grading Rules for Timber Posts	x		
07-01	Construction Sign CS5R	x		
07-03	Construction Identification Signs - CIS-1 & CIS-2	x		
07-08	Signing and Marking Bridge Ends and Obstructions			Delete
11-01	Furrow Ditch, Ditch Block and Sign Island	x		
11-02	Slope Rounding	x		
11-03	U-Turn Median Openings on Controlled Access Highways	x		
11-04	Roadway Embankment at Bridge End	x		
12-01	Haul or Overhaul		x	
12-02	Haul or Overhaul		x	
12-03	Haul or Overhaul		x	
13-01	Measurement of Roadway Rolling			Special Provisions

STANDARD NUMBER	NAME OF STANDARD	STANDARD DRAWING	STANDARD SHEET	OTHER
13-02	Measurement of Roadway Rolling			Special Provisions
20-01	Approaches	x		
39-01	8" P.C. Concrete Pavement Sawed Joints with Tie Bars	x S.U.		
39-02	8" P.C. Concrete Pavement Expansion Joints with Dowel Sleeves	x S.U.		
39-03	8" P.C. Concrete Pavement Sawed Joints	x S.U.		
39-04	8" P.C. Concrete Pavement Construction Joint and Header	x S.U.		
39-09	8" P.C. Concrete Pavement Keyway Joints	x S.U.		
39-10	P.C. Concrete Pavement Tapered Panel Connection	x S.U.		
39-14(A)	Standard Concrete Approach Slab to Structures	x		
39-14(B)	Standard Concrete Approach Slab to Structures	x		
39-15(A)	Standard Concrete Approach Slabs to structures with U-Type Abutments	x		
39-15(B)	Standard Concrete Approach Slabs to Structures with U-Type Abutments	x		

STANDARD NUMBER	NAME OF STANDARD	STANDARD DRAWING	STANDARD SHEET	OTHER
41-01	Box Culvert Data - Reference			Delete
41-05	Box Culvert Data-- Reference			Delete
50-01	Culvert Riprap	x		
50-02	Grouted Riprap			Delete
50-03	Riprap Quantities		x	
50-04	Embankment Protection	x		
50-05	Concrete Drainage Chute	x		
50-20(A)	Concrete Slope Protection			Delete
50-20(B)	Concrete Slope Protection			Delete
50-20(C)	Concrete Slope Protection			Delete
50-21(A)	Concrete Slope Protection - Alternate II	x		
50-21(B)	Concrete Slope Protection - Alternate II	x		
51-01	Metal Bin - Type Retaining Wall	x S.U.		
51-02	Concrete Crib Retaining Wall			Delete
51-03	Backfill Retainer and Cutoff Wall for Vehicular Underpass	x		

STANDARD NUMBER	NAME OF STANDARD	STANDARD DRAWING	STANDARD SHEET	OTHER
54-01	RCP Culvert Bedding	x		
54-02	Typical Field Cast Concrete Bend RCP to CMP Connection Detail	x		
54-03	Bedding Material		x	
54-04	Filter Material for Underdrains	x		
54-05	Syphon Pipe	x S.U.		
54-06	CSP & SSPP Culvert Bedding	x		
56-01	Fill Height for CSP, H-20 Loading, 2 2/3 x 1/2 Corrugations		x	
56-02	Fill Height for CSP, H-20 Loading, 3 x 1 Corrugations		x	
56-03	Thickness for Corrugated Steel Pipe 3 x 1 Corrugation H-20 Loading		x	
56-04	Thickness for Corrugated and Structural Plate Pipes for Railroad Cooper E-72 Live Load		x	
56-05	Corrugated Metal Syphon Pipe			Delete
56-06	Supports for Corrugated Metal Pipes		x	
56-07	Flared End Terminal Section Round Corrugated Metal Pipe	x		

STANDARD NUMBER	NAME OF STANDARD	STANDARD DRAWING	STANDARD SHEET	OTHER
56-10	Embankment Protector	x		
57-00	Fill Height for CSP Arch, 3 x 1 Corrugations		x	
57-01	Fill Height for CSP Arch, 2 2/3 x 1/2		x	
57-02	Flared End Terminal Section Corrugated Metal Pipe Arch Culvert	x		
57-03	Bevel on Corrugated Steel Pipe Arch	x		
59-00	Fill Height For C.S. P. H-20 Loading, 6 x 2 Corrugations		x	
59-01	Fill Height for C.S.P. Arch, 6 x 2 Corrugations		x	
59-02	Structural Plate Pipe Stockpass	x		
59-03	Step Bevel for Circular CSP and SSP	x		
59-04	Vehicular Underpass	x		
59-05	Bevel on Structural Plate Pipe-Arch	x		
59-06	Circular Vehicle Underpass Structural Plate Pipe		x	
62-01	Loading For Round R.C.P. Culverts		x	
62-02	Prefabricated Terminal Section for Reinforced Concrete Pipe	x		
62-03	Prefabricated Terminal Section for Reinforced Concrete Pipe	x		
62-04	Precast Split Section Reinforced Concrete Pipe			Delete
63-01	Prefabricated Concrete Underpass			Delete
63-02	Prefabricated R.C.P. Arch Culvert and Terminal Section	x		

STANDARD NUMBER	NAME OF STANDARD	STANDARD DRAWING	STANDARD SHEET	OTHER
65-01	Thickness for Corrugated Aluminum Pipe H-20 Live Load		x	
69-01	Semicircular Underdrain	x S.U.		
73-01	Wooden Division Box	x S.U.		
73-02	Concrete Division Box	x		
73-03	Pipe Drop			Delete
73-04	Inlet and Outlet Headwalls for R.C.P. and C.M.P. Pipes	x		
73-05	Cutoff Walls for Culverts	x		
73-06	Cutoff Wall Quantities		x	
73-07	Standard Ditch Drop			Delete
73-08	Concrete Edge Protection for Structural Plate Pipe Culverts and for Structural Plate Pipe Arch Culvert	x		
73-09	Concrete Edge Protection for Concrete Pipe Culverts	x		
73-10	Concrete Edge Protection for Concrete Arch Culverts	x		
75-01	Standard Curbs	x		

STANDARD NUMBER	NAME OF STANDARD	STANDARD DRAWING	STANDARD SHEET	OTHER
75-02	Concrete Median Curbs	x		
75-03	Precast Traffic Curb	x		
76-01	Concrete Sidewalk	x		
77-01	Combination Manhole and Catch Basin	x		
77-02	Drop Inlet Boxes and Covers	x		
77-03	Median Inlet Cover	x		
77-04	Median Inlet Cover Type "A" for Metal Riser			Delete
77-05	Precast Concrete Manhole	x		
77-06	Curb Inlet Box and Cover	x		
77-07	Median Inlet - 10.0 Ft. Median			Delete
80-01	Chain Link Fence	x		
80-02	Median Barrier Fence	x	S.U.	
81-01	Wire Fence - Interstate Type	x		
81-02	Wire Fence - Interstate Type	x		
81-03	Farm Fence	x		
82-01	Cattle Guard	x		

STANDARD NUMBER	NAME OF STANDARD	STANDARD DRAWING	STANDARD SHEET	OTHER
83-01	Wood Slat Snow Fence			Delete
85-01	Type I Pull Box Details	x		
85-02	Type II Pull Box Details			Delete
87-01	Traffic Signal and Highway Lighting Symbols			Delete
87-02	Electrical Service Details		x	
87-03	Controller Cabinet Details and Pedestals		x	
87-04	Signal Head Details		x	
87-05	Vehicular Signal Mountings		x	
87-06	Pedestrain Signal Mountings		x	
87-07	Type I Standard and Typical Equipment Mountings		x	
87-09	Pedestrain Push Button Details		x	
87-10	Type X Standard and Typical Equipment Mountings			Delete
87-10 A	Standard Aluminum Type 10-A		x	
87-12	Type II Standard and Typical Equipment Mountings		x	

STANDARD NUMBER	NAME OF STANDARD	STANDARD DRAWING	STANDARD SHEET	OTHER
87-18	Typical Wiring Diagram of Service Equipment		x	
87-21	Loop Detector Installation Detail		x	
87-22	Watertight Connectors		x	
87-42	Lighting Brackets and Installation Details		x	
87-43	Guy and Anchor Assemblies		x	
87-44	Tie Wire Detail			Delete
87-45	Insulator Assembly Details		x	
87-52	Installation Details Overhead Conductor-Steel Poles			Delete
88-02	Regulatory Sign Panel Specifications			Sign Manual
88-03	Warning Sign Panel Specifications			Sign Manual
88-04	Route Marker Panel Specifications			Sign Manual
88-06	R2-11, R4-10, R4-11 and R4-7			Sign Manual
88-07	Standard R2-12 Sign			Sign Manual
88-08	R4-12,R4-13, R10-8 and R10-9			Sign Manual
88-09	Signing of Median U-Turns			Sign Manual

STANDARD NUMBER	NAME OF STANDARD	STANDARD DRAWING	STANDARD SHEET	OTHER
88-10	Standard R2-8 Signs			Sign Manual
88-11	R4-14 and R4-15			Sign Manual
88-12	R4-9			Sign Manual
88-16	Standard W4-2 Warning Sign			Sign Manal
88-17	W6-4, W6-5, W12-3 and X3-2 Warning Signs			Sign Manual
88-18	W6-4A and W6-4B			Sign Manual
88-19	W8-9, W9-2, W9-5 and W9-6 Warning Signs			Sign Manual
88-26	Interstate Business Shields			Sign Manual
88-27	Primary Route Marker for Use on Guide Signs			Sign Manual
88-28	Secondary Route Marker for Use on Guide Signs			Sign Manual
88-29	Standard M1-6 and M1-7 Route Markers			Sign Manual
88-36	Typical Guide Sign Layout		x	
88-37	Informational Signs-Services			Sign Manual
88-37 A	Informational Signs - Rest Area			Sign Manual
88-38	Standard N6-2 Stream Name Sign Primary and Secondary Routes			Sign Manual

STANDARD NUMBER	NAME OF STANDARD	STANDARD DRAWING	STANDARD SHEET	OTHER
88-39	Weigh Station Signs			Sign Manual
88-47	Standard Rest Area and Information Signs			Sign Manual
88-48	Informational Signs			Sign Manual
88-56	Typical Approach Road Signing		x	
88-57	Rypical Sign Erection		x	
88-58	Typical Crossroad and Ramp Layout		x	
88-59	Typical Guide Sign Placement		x	
88-66	Standard Guide Signs		x	
88-67	Guide Sign Placement			Delete
88-68	Aluminum Sheet Increment Guide Signs	x		
88-69	Plywood Sheet Increment Guide Signs	x		
88-70	Guide Sign Mounting Details	x		
88-71	Railroad Crossing Signs			Delete
88-72	Railroad Crossing Signs			Sign Manual
88-73	Interstate and Primary Mileposts			Sign Manual
88-74	X1-1 Sign and Erection Detail			Sign Manual

STANDARD NUMBER	NAME OF STANDARD	STANDARD DRAWING	STANDARD SHEET	OTHER
88-75	Typical Pipe Post Mounting Detail		x	
88-76	Wood Pole Slot Detail	x		
88-77	Typical Sign Erection	x		
88-78	Typical Route Marker Assembly with Treated Timber Post	x		
88-79	Typical Route Marker Assembly with Treated Timber Pole	x		
88-80	Typical Route Marker Assemblies with Steel Posts	x		
88-81	Typical Sign Erection - Steel Posts	x		
88-91	Delineators Type I	x		
88-91 A	Delineators Type II	x		
88-92	Delineator Spacing for Horizontal Highway Curves	x		
90-00	5" Guide Posts	x		
90-01	Wood Guide Posts	x		
90-02	Metal Guard Rail	x		
90-03	Metal Median Rail	x		

STANDARD NUMBER	NAME OF STANDARD	STANDARD DRAWING	STANDARD SHEET	OTHER
90-04	Bridge End Treatment	x		
90-05	Guard Rail Terminal Sections - Sheet 1	x		
90-06	Guard Rail Terminal Sections - Sheet 2	x		
90-07	Pier Treatment	x		
90-14	Guard Rail for Grade Crossing Protection	x		
90-15	Combination Guard Rail and Header			Delete
90-16	Layout of Combination Guard Rail and Header			Delete
90-17	Reflector-Washer	x		
90-18	Flex Beam Guard Rail Bridge Approach			Delete
90-20	Cable Guard Rail	x S.U.		
90-21	Cable Guard Rail Driveway Anchor Section	x S.U.		
96-01	Monuments and Markers	x		
100-01	Outdoor Fireplace	x S.U.		
100-02	Grate Details for Concrete Fireplace	x S.U.		
100-03	Bench	x S.U.		
100-04	Park Bench	x S.U.		

STANDARD NUMBER	NAME OF STANDARD	STANDARD DRAWING	STANDARD SHEET	OTHER
100-05	Timber Picnic Table	x S.U.		
100-06	Stone Picnic Table	x S.U.		
100-07	Stone Picnic Table	x S.U.		
100-08	Two Table Picnic Shelter	x S.U.		
100-09	Well Shelter	x S.U.		
100-10	Exhibit Case	x S.U.		
100-11	Planting and Staking Procedures	x S.U.		
100-12	Garbage Can Rack	x S.U.		
100-13	Historical Marker	x S.U.		

File under Phase II

PROJECT CHARACTERISTICS

PROJECT NUMBER _____

SYSTEM:	INTERSTATE ☐	PRIMARY ☐	SECONDARY ☐	URBAN ☐
LENGTH:	MILES_____	MILES_____	MILES_____	MILES_____
GEOMETRICS:	NON-SYMMETRICAL ALIGNMENT	☐	MILES_____	
	TWO LANE	☐	MILES_____	
	FOUR LANE	☐	MILES_____	
CULTURE:	RURAL--IRRIGATED	☐	MILES_____	
	RURAL--NON-IRRIGATED	☐	MILES_____	
	URBAN--CURB & GUTTER	☐	MILES_____	
TERRAIN:	FLAT AND ROLLING	☐	MILES_____	
	MOUNTAINOUS AND VALLEY	☐	MILES_____	
SPECIAL FEATURES:	INTERCHANGE (S)	☐	NUMBER_____	
	WEIGH STATION (S)	☐	NUMBER_____	
	REST AREA (S)	☐	NUMBER_____	
	MAJOR INTERSECTION (S)	☐	NUMBER_____	
	FRONTAGE ROAD (S)	☐	MILES_____	
	BRIDGE (S)	☐	NUMBER_____	
	MAJOR PIPE (S)	☐	NUMBER_____	
CHARACTER-ISTICS:	GRADING	☐		
	SURFACING	☐		
	FENCING	☐		
	SIGNING	☐		
	LIGHTING	☐		
	RICHT-OF-WAY REQUIRED	☐		
	UTILITIES REQUIRED	☐		

File Under Phase II

ROAD
DESIGN
CHECK LIST

CHECK SHEET

ITEM AND DESCRIPTION	PRELIMINARY P.P.T.H.	PRELIMINARY F.P.T.H.	FINAL DESIGNER	FINAL CHECKER
Title Sheet				
1. Project Number and Name and Agreement Number				X
2. Beginning and Ending Stations	X	X	X	
3. Major Feature Station Locations		X	X	
4. Project Splits		X		X
5. Layout Map				
+. Alignment	X		X	
+. Township, Range and Ties	X		X	
+. Orientation of North Arrow	X		X	
6. Signature Block	X		X	
7. Design Data	X		X	
8. Plan Scales	X		X	
9. Optioned Surfacing and Borrow Source		X		X
Symbols and Abbreviations				
1. Consistent Usage	X	X	X	
Table of Contents				
1. Verify Sheet Numbers and Prefix		X	X	
2. Proper Project Number on Pages				X
3. Correct Title Headings and Sub-headings		X	X	
Notes				
1. Standard Notes				
+. Skew Diagram	X	X	X	
+. Bases for Plan Quantities for Surfacing	X	X		X
+. Slope Notes	X		X	

ITEM AND DESCRIPTION	PRELIMINARY		FINAL	
	P.P.T.H.	F.P.T.H.	DESIGNER	CHECKER
5. Station Call Outs and Notes		X	X	
6. North Arrow Orientation		X	X	
7. Township, Range and Ties		X	X	
8. Section Lines		X	X	
9. Right of Way Limits		X		X
10. Control of Access		X		X
11. Connection to P.T.W.		X		X
CROSS SECTIONS				
1. Notes		X	X	
2. Typical Template		X	X	
3. Topography		X	X	
4. Areas and Volumes		X	X	

ITEM AND DESCRIPTION	PRELIMINARY P.P.T.H.	PRELIMINARY F.P.T.H.	FINAL DESIGNER	FINAL CHECKER
18. Monuments and Markers Frame		X		X
19. Miscellaneous to be Removed by Contractor Frame (Bid Items)		X		X
20. Reset and Adjustment Frame		X		X
DETAIL				
1. Required Detail Drawings				
+. Quantities		X	X	
+. Dimensions		X	X	
+. Notes		X		X
2. Required Standard Drawings		X		X
3. Mass Diagram (Single Page)		X		X
PLAN AND PROFILE				
1. Alignment				
+. Staked	X	X		X
+. Projected	X	X		X
2. Topography				
+. Utility				X
+. Irrigation and Drainage			X	
+. Buildings			X	
+. Other Miscellaneous Topography			X	
3. Grade				
+. I.B.M. Runs	X	X		X
+. Profile	X	X		X
+. Vertical Curve Data	X	X		X
4. Mass Diagram (Large Scale)		X	X	

ITEM AND DESCRIPTION	PRELIMINARY P.P.I.H.	PRELIMINARY F.P.I.H.	FINAL DESIGNER	FINAL CHECKER
+. Control of Access Note		X	X	
+. Project Staking Note		X	X	
2. Non-Standard Notes				
+. Misc. to be Removed or Moved by Others		X		X
+. Misc. to be Removed by Contractor Note (Absorbed Items)		X	X	
+. Do Not Disturb Note		X	X	
+. Clearing and Grubbing Note		X	X	
+. Dump Area Note		X	X	
+. Furrow Ditches		X	X	
+. Approaches Note		X	X	
+. Seeding Note		X		X
+. Detour Note		X	X	
Linear and Level Data				
1. Lineal Data				
+. Total Length of Project		X		X
+. Length of Structures		X		X
+. Equation Adjustments		X		X
+. Project Splits		X		X
2. Bearings Note		X		X
3. Bench Mark				
+. Location and Description		X	X	
+. Elevation		X	X	
+. Level Datum Source and Description		X	X	

ITEM AND DESCRIPTION	PRELIMINARY P.P.I.H.	PRELIMINARY F.P.I.H.	FINAL DESIGNER	FINAL CHECKER
Typical Section				
1. Dimensions				
+. Vertical	X	X		X
+. Horizontal	X	X		X
2. End Areas and Volumes	X	X		X
3. Applicable Stationing for Typical Section	X	X	X	
4. Typical Numbers	X	X	X	
5. Typical Titles	X	X	X	
6. Surfacing Lift Descriptions and Types	X	X		X
7. Profile Elevation Note	X	X	X	
Summaries				
1. Grading Frame	X	X		X
2. Additional Excavation Frame		X		X
3. Topsoil Frame		X		X
4. Culvert Frame		X		X
5. Culvert-Alternate Frame		X		X
6. Irrigation Frame		X		X
7. Embankment Protector Frame		X		X
8. Drainage Frame		X		X
9. Slope Protector Frame		X		X
10. Surfacing Frame		X		X
11. Additional Surfacing Frame		X		X
12. Seeding Frame		X		X
13. Guard Rail and Median Rail Frame		X		X
14. Curb and Gutter Frame		X		X
15. Sidewalk Frame		X		X
16. Cattle Guard Frame		X		X

ITEM	PLANNED	ACTUAL	COMMENTS
Parks and Recreation:			
Notified			
Approved			
County Approval of Plans			
Railroad Approval of Plans			
Airport Clearance Date			
Top Soil Report Date			
Fencing Report Date			

ITEM	PLANNED	ACTUAL	COMMENTS
Final Plan In Hand:			
Date Held			
Plan In Hand Report:			
Date Submitted			
Date Approved			
Plans to Contract Plans Unit:			
Road Plans and Cross Sections			
Surfacing Design Sheet			
Special Features			
Fencing			
Utility			
Signing			
Electrical			
Bridge Plans			
Special Provisions			
P.S. & E. Approval Date			
Contract Letting Date			
Forms Approval:			
County Resolution Date			
City Agreement Date			
By-Pass Approval Date			
Special Agreement Date			
Project Agreement			
Fish and Game:			
Notified			
Approved			
Forest Service:			
Notified			
Approved			

Under Section 4 which lists jobs excluded from the law, paragraph (j) states, "Any individual employed in a bona fide executive, administrative, or professional capacity as these terms are defined and delimited by regulations of the commissioner".

At this time the Commissioner of Labor has not defined the terms executive, administrative, and professional. Until he does the impact of H.B. 338 on the Highway Department's overtime policies and personnel services costs will remain unknown.

AMOUNTS OF OVERTIME WORKED
BY TYPE OF EMPLOYEE

CONDITIONS OF EMPLOYMENT SURVEY

	Percent of Employers				
Type of Employee	None or Rare	20 to 50 Hrs./Yr.	51 to 100 Hrs./Yr.	101 to 150 Hrs./Yr.	Over 150 Hrs./Yr.
Clerical and Office	66	15	6	6	7
Technical and Field	15	14	15	19	37
Professional	21	6	6	19	48

MONTANA HIGHWAY COMMISSION

Clerical and Office	X				
Technical and Field					
Helena	X				
Field			X		
Professional	(Various)				

TYPES OF OVERTIME COMPENSATION
BY PERCENT OF EMPLOYERS AND TYPE
OF EMPLOYEES

CONDITIONS OF EMPLOYMENT SURVEY

	Percent of Employers				
Type of Employee	No Compensation	Cost at Straight Time Rates	Cost at Time and One-Half	Compensatory Time at Straight Time	Compensatory Time at Time and One-Half
Clerical and Office	23	2	68	7	
Technical and Field	12	2	80	2	4
Professional	51	2	35	6	6

MONTANA HIGHWAY COMMISSION

Clerical and Office			X
Technical and Field			
G-17 and Below			X
G-19, G-21 and G-23	*		
Professional	X		

* Overtime compensation is built into the monthly salary.

BONUS PAYMENTS

Existing Conditions -- Conditions of Employment Survey

About half of the private (non-government) employers reported that they gave bonuses to some or all of their employees during the last year. Some of the employers gave bonuses to all employees while others gave bonuses to specific groups of employees.

The total range of bonuses by percentage of annual salary was from 3 percent to 30 percent and the range of dollar bonuses was from $100 to $2,340.

Existing Conditions -- Montana Highway Commission

No bonuses are given to Highway employees.

HOLIDAYS

Existing Conditions -- Conditions of Employment Survey

Paid holidays are provided by 95 percent of the employers. The number of holidays provided ranges from 6 to 11 per year. The average is 7 holidays per year.

Only two employers reported that they provide no paid holidays.

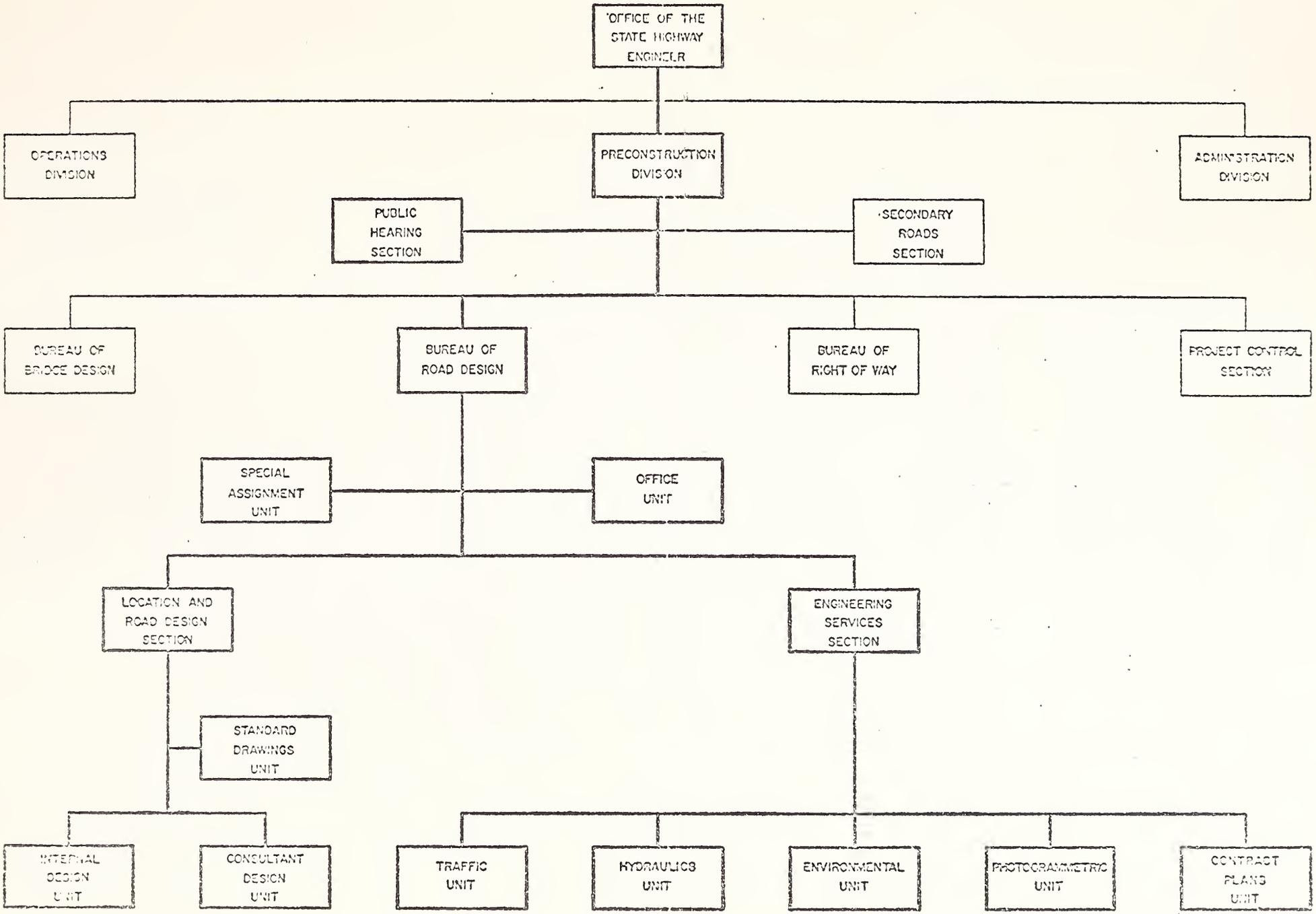
Existing Conditions -- Montana Highway Commission

Highway employees receive 10 paid holidays plus elections and those days granted by the Governor of Montana.

PROJECT DATES

ITEM	PLANNED	ACTUAL	COMMENTS
PR #1 Approval Date			
Clearing House Approval Date			
Environmental Approval Date			
Location Public Hearing Date			
Location Report:			
Date Submitted			
Date Approved			
Field Survey:			
Date Authorized			
Date Submitted			
Planning Report:			
Date Submitted			
Date Approved			
First Set of Brownlines sent to R/W			
Preliminary Plan In Hand:			
Date Held			
Preliminary Plan In Hand Report:			
Date Submitted			
Date Approved			
Second set of Brownlines to R/W			
Design Public Hearing Date			
Design Study Report:			
Date Submitted			
Date Approved			
Date R/W Plans Submitted to R/W Div.			
Date Utility Plans Submitted to R/W Div.			
Power Source Secured			

ORGANIZATION


OFFICE OF THE STATE HIGHWAY ENGINEER
OPERATIONS DIVISION
PRECONSTRUCTION DIVISION
ADMINISTRATION DIVISION
PUBLIC HEARING SECTION
SECONDARY ROADS SECTION
BUREAU OF BRIDGE DESIGN
BUREAU OF ROAD DESIGN
BUREAU OF RIGHT OF WAY
PROJECT CONTROL SECTION
SPECIAL ASSIGNMENT UNIT
OFFICE UNIT
LOCATION AND ROAD DESIGN SECTION
ENGINEERING SERVICES SECTION
STANDARD DRAWINGS UNIT
INTERNAL DESIGN UNIT
CONSULTANT DESIGN UNIT
TRAFFIC UNIT
HYDRAULICS UNIT
ENVIRONMENTAL UNIT
PHOTOGRAMMETRIC UNIT
CONTRACT PLANS UNIT

CHIEF, BUREAU OF ROAD DESIGN

I. FUNCTION

The Chief, Bureau of Road Design accomplishes the location and design of all highway projects required in the Construction program and administers all design service unit activities including those of Hydraulics, Traffic, Environmental, Photogrammetrics and Contract Plans in accordance with Department and statutory requirements.

II. RESPONSIBILITY AND AUTHORITY

Within the limits of Department policy and in accordance with approved procedures, the Chief, Bureau of Road Design is responsible for and has the authority to perform or cause to be performed the following:

A. Activities

1. Directs or supervises the following subordinate positions:

   a) Supervisor of Location and Road Design Section
   b) Supervisor of Engineering Service Section
   c) Manager of Special Assignments Unit
   d) Manager of Office Unit

2. Implements Department policy and develops recommendations for warranted changes in policy that affect the road design function.

3. Approves procedures in accordance with Department policy for use in the performance of design or design service functions.

4. Participates in the long-range highway planning function, including programming of projects in the Five-Year Plan.

5. Approves project schedules and ensures accomplishment of scheduled objectives.

6. Develops budgets for the Bureau of Road Design and approves expenditures of funds.

7. Approves and implements the planning guidelines for use in planning, programming and scheduling work. Periodically reviews the validity of the values and recommends revisions based on legislative action, Federal Highway Administration requirements, Bureau experience or other appropriate criteria.

8. Approves the training program.

9. Approves standard drawings and standard sheets.

10. Provides for the location, design and engineering, authorization to receive bids and contract negotiations in accordance with statutory requirements.

11. Provides for contracts with consulting firms for the preliminary engineering and design of highways.

12. Provides for the necessary documentation of projects in accordance with statutory regulations, Department policy and Federal Highway Administration requirements.

B. Organization

1. Develops and maintains an effective and economic organization in the Bureau of Road Design.

2. Ensures that all employees in the Bureau of Road Design understand the responsibilities of their positions and that position guides, policies and procedures for the Bureau of Road Design are current and adequate.

3. Delegates authority to subordinates consistent with their duties and abilities.

C. Personnel

1. Provides for the training and development of employees within the Bureau of Road Design.

2. Approves personnel actions affecting subordinates.

3. Approves staffing requirements of the Bureau of Road Design based on workload and optimum manpower utilization and benefit-costs.

4. Provide for performance review and appraisal of subordinates.

III. RELATIONSHIPS

A. With the Administrator, Preconstruction Division --

1. Accounts to him for the direction and execution of responsibilities in the Bureau of Road Design.

2. Advises of significant developments and reviews major programs and plans for the Bureau of Road Design.

B. With the Chief, Bureau of Bridge Design --

1. Coordinates the road design function with him to ensure that road design factors are considered in the design of structure projects.

C. With the Supervisor of the Project Control Section --

1. Coordinates road design matters with him to ensure coordinated efforts toward Department objectives and integration of road design and design service activities with long-range planning activities.

D. With other Divisions, Sections and Districts --

1. Develops and maintains close relationships to ensure that Bureau of Road Design factors are considered, where appropriate, in decisions related to that function.

E. With the Federal Highway Administration, other Agencies, Contractors and Suppliers --

1. Establishes and maintains those relationships which are in the best interest of the Department and are necessary for the accomplishment of his function.

F. With the General Public --

1. Establishes and maintains those relationships which are in the best interest of the Department and are necessary for the accomplishment of his function.

2. Acts in the capacity as a representative of the State Highway Engineer.

LOCATION AND ROAD DESIGN SUPERVISOR

I. FUNCTION

The Supervisor, Location and Road Design Section directs and controls all internal and external road design activities required in the construction program.

II. RESPONSIBILITY AND AUTHORITY

Within the limits of Department policy and in accordance with approved procedures, the Supervisor, Location and Road Design Section is responsible for and has the authority to perform or cause to be performed the following:

A. Directs or supervises the following subordinate positions:

1. Manager, Consultant Design Unit
2. Area Engineers
3. Manager, Standard Drawings Unit

B. Develops design program schedules and recommends adoption of schedule objectives.

C. Approves short-range design project schedules, analyzes the schedules to determine the staffing requirements and initiates personnel changes necessary to effect maximum manpower utilization.

D. Develops and recommends changes in procedure designed to improve the effectiveness of the design operations.

E. Provides for the development of standard drawings and standard sheets.

F. Provides for the coordination of all field design crews in the accomplishment of road design according to adopted Department policy and procedure as well as Federal Highway Administration requirements.

G. Provides guidance and assitance to all outside governmental agencies in carrying out the provisions of all federal and state highway programs which relate to road design.

H. Approves final project design.

III. RELATIONSHIPS

A. With the Chief, Bureau of Road Design --

1. Reports to and is accountable to the Chief, Bureau of Road Design for the proper interpretation and effective performance of his duties and responsibilities.

B. With the Supervisor, Engineering Services Section --

1. Coordinates design matters with him to ensure a coordinated effort toward meeting project objectives.

2. Advises of significant project developments which will affect service activities and schedules.

C. With the Chief, Bureau of Right of Way --

1. Coordinates road design and right of way plan preparation to ensure coordinated efforts toward Department objectives.

D. With the Chief, Bureau of Bridge Design --

1. Coordinates the road design function with him to ensure that road design factors are considered in the design of structures.

E. With the Federal Highway Administration, other Agencies, Contractors and Suppliers --

1. Establishes and maintains those relationships which are in the best interest of the Department and are necessary for the accomplishment of his function.

F. With the General Public --

1. Establishes and maintains those relationships which are in the best interest of the Department and are necessary for the accomplishment of his function.

ENGINEERING SERVICES SUPERVISOR

I. FUNCTION

The Supervisor, Engineering Services Section directs and controls all engineering service activities including those of Hydraulics, Traffic, Environmental, Photogrammetric and Contract Plans as required to fulfill the construction program.

II. RESPONSIBILITY AND AUTHORITY

Within the limits of Department policy and in accordance with approved procedures the Supervisor, Engineering Service Section is responsible for and has the authority to perform or cause to be performed the following:

A. Directs or supervises the following subordinate positions:

1. Manager, Traffic Unit
2. Manager, Hydraulics Units
3. Manager, Environmental Unit
4. Manager, Photogrammetric Unit
5. Manager, Contract Plans Unit

B. Coordinates engineering service activities in support of road and bridge design, right of way acquisition and all Department units where those services are required.

C. Approves short-range schedules and recommends adoption of schedule objectives for support activities.

D. Develops and recommends changes in procedure designed to improve the effectiveness of the engineering service operations.

E. Provide liaison with political subdivisions which require specialized engineering services.

III. RELATIONSHIPS

A. With the Chief, Bureau of Road Design --

1. Reports to and is accountable to the Chief, Bureau of Road Design for the proper interpretation and effective performance of his duties and responsibilities.

B. With the Supervisor, Location and Road Design Section --

1. Coordinate engineering services with him to ensure a coordinated effort toward meeting project objectives.

2. Advises of significant projected developments which will effect road design activities and schedules.

C. With the Federal Highway Administration, other Agencies, Contractors and Suppliers --

1. Establishes and maintains those relationships which are in the best interest of the Department and are necessary for the accomplishment of his function.

D. With the General Public --

1. Establishes and maintains those relationships which are in the best interest of the Department and are necessary for the accomplishment of his function.

MANAGER, TRAFFIC UNIT

I. FUNCTION

The Manager, Traffic Unit administers the design of traffic control devices; development of proposed standards for traffic control; conduct of special traffic and accident studies; and coordination with the Districts and other engineering sections.

II. RESPONSIBILITY AND AUTHORITY

Within the limits of Department policy and in accordance with approved procedures, the Manager, Traffic Unit is responsible for and has the authority to perform or cause to be performed the following:

A. Supervise the work activities of personnel assigned to the Traffic Unit.

B. Directs and controls the preparation of plans and specifications for fabrication and erection of signs and sign structures, installation and operation of traffic control devices.

C. Formulates and reviews policies, procedures, standards and specifications for the design, manufacture, and use of traffic control devices.

D. Conducts traffic research, and recommends improvements related to traffic control and safety.

E. Develops project assignments for signing project design.

F. Ensures accomplishment of all activities within specified time limits by altering work assignments to accommodate fluctuations in workload.

G. Provides review of geometric design of road plans as related to traffic operation.

H. Develops and recommends the Highway Safety Improvement program including the gathering of supporting data on accidents before and after an improvement.

III. RELATIONSHIPS

A. With the Supervisor, Engineering Services Section --

1. Reports to and is accountable to the Supervisor, Engineering Services Section for the proper interpretation and effective performance of his duties and responsibilities.

B. With the Federal Highway Administration, other Agencies, Contractors and Suppliers --

1. Establishes and maintains those relationships which are in the best interest of the Department and are necessary for the accomplishment of his function.

C. With the General Public --

1. Establishes and maintains those relationships which are in the best interest of the Department and are necessary for the accomplishment of his function.

MANAGER, HYDRAULICS UNIT

I. FUNCTION

The Manager, Hydraulics directs and controls all specialized hydraulics design.

II. RESPONSIBILITY AND AUTHORITY

Within the limits of Department policy and in accordance with approved procedures, the Manager, Hydraulics Unit is responsible for and has the authority to perform or cause to be performed the following:

A. Supervises the work activities of personnel assigned to the Hydraulics unit.

B. Directs and controls the preparation of plans and specifications for the design and use of specialized drainage and irrigation structures.

C. Formulates and reviews policies, procedures, standards and specifications for the design, manufacture and use of non-specialized drainage, irrigation structures, and special feature facilities.

D. Conducts research and recommends improvements related to hydraulic design.

E. Develops project assignments for hydraulic design.

F. Ensures accomplishment of all activities within specified time limits by altering work assignments to accommodate fluctuations in workload.

G. Determines the validity of landowner claims relative to hydraulic problems.

III. RELATIONSHIPS

A. With the Supervisor, Engineering Services Section --

1. Reports to and is accountable to the Supervisor, Engineering Services Section for the proper interpretation and effective performance of his duties and responsibilities.

B. With the Federal Highway Administration, other Agencies, Contractors and Suppliers --

1. Establishes and maintains those relationships which are in the best interest of the Department and are necessary for the accomplishment of his function.

C. With the General Public --

1. Establishes and maintains those relationships which are in the best interest of the Department and are necessary for the accomplishment of his function.

D. With other Divisions, Sections and Districts --

1. Develops and maintains close relationships to ensure that factors are considered, where appropriate, in decisions relative to Hydraulics design.

POSITION GUIDE

MANAGER, PHOTOGRAMMETRIC UNIT

I. FUNCTION

The Manager, Photogrammetric Unit administers the development of photogrammetry work schedules; development of flight controls; conduct of photogrammetric work; and coordination with the Districts, Department pilot and engineering sections.

II. RESPONSIBILITY AND AUTHORITY

Within the limits of Department policy and in accordance with approved procedures, the Manager, Photogrammetric Unit is responsible for and has the authority to perform or cause to be performed the following:

A. Supervises the work activities of personnel assigned to the Photogrammetric Unit.

B. Plans and coordinates the obtaining of aerial photographs.

C. Plans and coordinates the necessary ground control required for aerial photography.

D. Prepares contour maps from aerial photographs with stereo plotters.

E. Conducts research and recommends improvements related to photogrammetric services.

F. Ensures accomplishment of all activities within specified time limits by altering work assignments to accommodate fluctuations in workload.

G. Determines the type of generals surveys to be conducted in specific projects.

H. Provides for the photogrammetric work relative to the finalization of construction projects.

III. RELATIONSHIPS

A. With the Supervisor, Engineering Services Section --

1. Reports to and is accountable to the Supervisor, Engineering Services Section for the proper interpretation and effective performance of his duties and responsibilities.

B. With the Chief pilot --

1. Coordinates work schedules in order to perform flights which meet project schedule requirements.

C. With the Supervisor, Photographic Section --

1. Coordinates work schedules in order to perform photogrammetric services and research which meet project requirements.

D. With other Divisions, Sections, and Districts --

1. Develops and maintains close relationships to ensure that factors are considered, where appropriate, in decisions relative to the Photogrammetric Unit.

MANAGER, ENVIRONMENTAL UNIT

I. FUNCTION

The Manager, Environmental Unit directs and controls all specialized landscape and beautification design and conducts studies relative to general environmental services.

II. RESPONSIBILITY AND AUTHORITY

Within the limits of Department policy and in accordance with approved procedures, the Manager, Environmental Unit is responsible for and has the authority to perform or cause to be performed the following:

A. Supervises the work activities of personnel assigned to the Environmental Unit.

B. Directs and controls the preparation of landscape and beautification plans for all special roadway features.

C. Formulates and reviews policies, procedures, standards and specifications for the design of seeding and mulch installations, and other roadside development services.

D. Reviews the environmental statements and recommends adjustments where required.

E. Provides guidance on all design plans on the environmental effects of the design.

F. Provides systems for complying with all Department and Federal Highway Administration requirements for protection of the environment.

G. Ensures accomplishment of all activities within specified time limits by altering work assignments to accommodate fluctuations in work load.

III. RELATIONSHIPS

A. With the Supervisor, Engineering Services Section --

1. Reports to and is accountable to the Supervisor, Engineering Services Section for the proper interpretation and effective performance of his duties and responsibilities.

B. With The Federal Highway Administration, other Agencies, Contractors and Suppliers --

1. Establishes and maintains those relationships which are in the best interest of the Department and are necessary for the accomplishment of his function.

C. With other Divisions, Sections and Districts --

1. Develops and maintains close relationships to ensure that factors are considered, where appropriate, in decisions relative to Environmental Services.

D. With the General Public--

1. Establishes and maintains those relationships which are in the best interest of the Department and are necessary for the accomplishment of his function.

MANAGER, CONTRACT PLANS UNIT

I. FUNCTION

The Manager, Contract Plans Unit administers the development of contract letting documents and related instruments; development of Engineers' estimates of project costs; conduct of contract lettings; and coordination of bids and agreements between the Department and contractors, private companies, Federal Highway Administration and other governmental agencies.

II. RESPONSIBILITY AND AUTHORITY

Within the limits of Department policy and in accordance with approved procedures, the Manager, Contract Plans Unit is responsible for and has the authority to perform or cause to be performed the following:

A. Supervises the work activities of personnel assigned to the Contract Plans Unit.

B. Coordinate with the various Sections and Departments to ensure that complete and accurate documents are available at the proper time for preparation of the contract documents.

C. Check plans from the various sections to see that they are compatible and will result in contract documents where the format, continuity, conformance with Standard Specifications and Drawings, Federal Highway Administrations regulations and clarity to prospective bidders are adequately met.

D. Develop the contract documents, estimate, city and county agreements and perform other related functions necessary to obtain, from the Federal Highway Administration, P S & E Approval and authority to advertise projects for letting.

E. Arrange for reproducing and assembling of plans and proposals and mail contract documents to prospective bidders, suppliers and department personnel-maintain records and invoices.

F. Perform the various requirements (advertisements, addendum, opening and processing of bids) relative to letting of a project together with post-letting requirements.

III. RELATIONSHIPS

A. With the Supervisor, Engineering Services Section --

1. Reports to and is accountable to the Supervisor, Engineering Services Section for the proper interpretation and effective performance of his duties and responsibilities.

B. With other Divisions, Sections and Districts --

1. Develops and maintains close relationships to ensure that factors are considered, where appropriate, in decisions relative to contract documents and related instruments.

C. With the Federal Highway Administration, other Agencies, Contractors and Suppliers --

1. Establishes and maintains those relationships which are in the best interest of the Department and are necessary for the accomplishment of his function.

MANAGER, SPECIAL ASSIGNMENTS UNIT

I. FUNCTION

The Manager, Special Assignment Unit directs or controls all non-routine analysis projects, and provide guidance to all Department organizational units relative to specials situations in the Bureau of Road Design.

II. RESPONSIBILITY AND AUTHORITY

Within the limits of Department policy and in accordance with approved procedures, the Manager, Special Assignments Unit is responsible for and has the authority to perform or cause to be performed the following:

A. Supervises the secretaries for the Bureau of Road Design.

B. Provides assistance in developing information which is non-routine in nature required for supporting information for problem solving.

C. Assists units in the Bureau of Road Design in procedure change recommendations.

D. Develops and recommends ways of determining the current and future training needs of the Bureau.

E. Develops and recommends policies and procedures designed to establish and maintain training of the Bureau of Road Design.

F. Analyzes the production reports of all Bureau of Road Design organizational units periodically to determine the validity of approved planning values--make recommendations for changes when warranted.

G. Provides for the Distribution of the mail.

III. RELATIONSHIPS

A. With the Chief, Bureau of Road Design --

1. Reports to and is accountable to the Chief, Bureau of Road Design for the proper interpretation and effective performance of his duties and responsibilities.

B. With the Administration, Preconstruction Division --

1. Gathers and develops data as requested relative to matters of concern to the Bureau of Road Design.

C. With all Bureau of Road Design Organization Units --

1. Maintains effective relationships to ensure full consideration of all applicable data and conditions on which the procedures are based.

AMOUNTS OF EMPLOYER PARTICIPATION
IN EMPLOYEE HEALTH INSURANCE PLANS
BY TYPE OF EMPLOYER

Type of Employer	Monthly Dollar Cost - Total Range	Monthly Dollar Cost - Weighted Average
Industry and Utilities	$17.80 to $25.00	$23.60
Contractors	2.00 to 57.60	26.00
Federal Agencies	12.50 to 18.70	14.70
Services	8.00 to 35.00	21.10
Local Government and Other State Agencies	6.70 to 10.00	8.00
TOTAL	6.70 57.60	22.70
Montana Highway Commission		7.50 (current) 10.00 (7-1-71)

DISTRIBUTION OF BONUS PAYMENTS
PAID BY PRIVATE EMPLOYERS

Type of Employee	Percent of Employers: No Bonus	Percent of Employers: Percent of Salary Bonus	Percent of Employers: Dollar Amount Bonus	Percent of Ann. Sal. Range	Average Bonus Percentage	Dollar Range	Average Dollar Bonus
Office and Clerical	51	29	20	3 to 30%	10.8%	$100- 900	$ 500
Technical and Field	64	20	16	5 to 20%	9.7	240- 840	540
Professional and Administrative	55	27	18	5 to 30%	12.3	620-2340	1240

Montana Highway Commission (No Bonuses)

AMOUNT OF EMPLOYER CONTRIBUTION IN COST OF EMPLOYEE RETIREMENT PLANS BY TYPE OF EMPLOYER

Type of Employer	Percent of Salary — Total Range	Percent of Salary — Weighted Average
Industry and Utilities*	---	---
Contractors	5.0 to 15.0	8.8
Federal Agencies	7.0	7.0
Services	3.0 to 8.3	5.5
Local Government and Other State Agencies	3.5 to 6.1	4.6
TOTAL	3 to 15	7%
Montana Highway Commission		4.3 (current) 4.6 (7-1-71) 4.9 (7-1-73) 5.2 (7-1-75)

* The participating industries and utilities were unable to compute the percentage cost.

HEALTH AND LIFE INSURANCE

Existing Conditions -- Conditions of Employment Survey

A wide variety of health insurance plans are provided by participating employers. Ninety-three percent of the employers participate to some degree in the cost of health insurance plans for their employees.

The total range of participation is from $2.00 per month to $57.00 per month with an average participation of $22.00.

Fifty percent of the employers provide a variety of life insurance plans. Some are included in the retirement programs or health insurance plans. Some are fully paid by the employer and some are optional and paid by the employee.

Existing Conditions -- Montana Highway Commission

The Highway Commission provides a group health plan with MPS (Montana Physicians Service). Included in the plan is a life insurance policy for $5,000.00. Employees do not have the option of whether to accept or decline the life insurance coverage. Monthly rates for the MPS health plan are:

Single employee	$ 15.71
Employee and one dependent	$ 30.03
Employee and two or more dependents	$ 38.25

The Highway's contribution to the above premiums is currently $7.50 per month. It will increase to $10.00 per month on July 1, 1971.

RETIREMENT

Existing Conditions -- Conditions of Employment Survey

Retirement plans in addition to Social Security are provided by 41 percent of the participating employers.

The employer participation in employee retirement plans ranges from 3 percent to 15 percent of annual salary with an average of 7 percent.

Existing Conditions -- Montana Highway Commission

Highway employees are covered by the Public Employees Retirement System. They are also covered by Social Security.

The Highway participation in the retirement plan is presently 4.3 percent of the employee's annual salary. The rate of participation will increase to 4.6 percent on July 1, 1971 and will continue to increase 0.3 percent every two years until it reaches a maximum of 5.2 percent on July 1, 1975.

Employee participation is at the rate of 5.75 percent of his salary.

SICK LEAVE

Existing Conditions -- Conditions of Employment Survey

Paid sick leave is a practice not as widely accepted by employers as is annual leave. Sixteen percent of the survey participants do not provide sick leave for their employees. Thirty-four percent of survey participants provide sick leave benefits but have no schedules for accrual or use. Twelve percent provide sick leave benefits to all employees on a graduated scale based on length of service and 42 percent provide sick leave benefits on the basis of flat rate for all employees without regard to length of service.

Existing Conditions -- Montana Highway Commission

Highway employees receive sick leave at the flat rate of 12 days per year. There is no limit on the number of days which may be accumulated.

DAYS OF PAID VACATION PROVIDED BY YEARS OF EMPLOYEE SENIORITY AND TYPE OF EMPLOYER

Type of Employer	Days of Paid Vacation					
	Less Than 2 Years Service	3 to 5 Years Service	6 to 10 Years Service	11 to 15 Years Service	16 to 20 Years Service	Over 20 Years Service
Industry and Utilities						
Range	5-10	10	10-15	15-20	15-20	20
Weighted Average	7	10	12	17	17	20
Contractors						
Range	5-15	5-15	10-15	10-15	10-20	10-20
Weighted Average	9	10	10	11	1	11
Federal Agencies						
Weighted Average	13	20	20	20	26	26
Services						
Range	0-12	10-13	10-16	10-20	10-20	10-20
Weighted Average	10	11	11	13	14	15
Local Government and Other State Agencies						
Range	12-15	14-15	15	15-18	15-21	20-24
WeightedAverage	14	15	15	17	19	23
Montana Highway Commission	15	15	15	18	21	24

PAID VACATIONS

Existing Conditions -- Conditions of Employment Survey

Paid vacations are provided by 91 percent of the employers. Among employers that provide paid vacations, 54 percent allow a constant amount each year regardless of seniority and 46 percent provide graduated amounts based on the length of service.

Existing Conditions -- Montana Highway Commission

State employees earn vacation at the rate of 15 days per year for the first 10 years of service; 18 days vacation per year are earned for 11 through 15 years of service; 21 days vacation per year are earned for 16 through 20 years of service; and employees with 21 years of service or more earn 24 days vacation each year.

Note: This past year Highway employees forfeited 488 days of earned vacation.

MANAGER, OFFICE UNIT

I. FUNCTION

The Manager, Office Unit directs and controls the collection and reporting of all financial and statistical data, and supervises the accounting, payroll and purchasing function of the Bureau of Road Design.

II. RESPONSIBILITY AND AUTHORITY

Within the limits of Department policy and in accordance with approved procedures, the Manager, Office Unit is responsible for and has the authority to perform or cause to be performed the following:

A. Directs or supervises the work activities of personnel assigned to the Office Unit.

B. Provides systems for complying with all Department and Federal Highway Administration requirements for financial, statistical and management reporting.

C. Provides financial, fiscal accounting, payroll, and purchasing services for the Bureau of Road Design.

D. Receives all mail and distributes.

III. RELATIONSHIP

A. With the Chief, Bureau of Road Design --

1. Reports to and is accountable to the Chief, Bureau of Road Design for the proper interpretation and effective performance of his duties and responsibilities.

B. With the Department Accounting Personnel --

1. Maintains effective relationships to ensure maximum cooperation in all matters dealing with the Bureau of Road Design.

C. With Federal Highway Administration Personnel --

1. Maintains relationships with the Federal Highway Administration personnel that will facilitate the free flow of information and promote understanding of Bureau policies, procedures and problems.

MANAGER, STANDARD DRAWINGS UNIT

I. FUNCTION

The Manager, Standard Drawings Unit directs and controls the development and required research for the development of the standard drawings and sheets.

II. RESPONSIBILITY AND AUTHORITY

Within the limits of Department policy and in accordance with approved procedures, the Manager, Standard Drawings Unit is responsible for and has the authority to perform or cause to be performed the following:

A. Supervises the Work activities of personnel assigned to the Standard Drawings Unit.

B. Develops and recommends all standard drawings and sheets.

C. Maintains the Design Management Manual and Design Manual.

D. Conducts research and recommends improvements related to standard drawings and standard sheets.

III. RELATIONSHIPS

A. With the Supervisor, Location and Road Design Section--

1. Reports to and is accountable to the Supervisor, Location and Road Design Section for the proper interpretation and effective performance of his duties and responsibilities.

B. With other Divisions, Sections and Districts --

1. Develops and maintains close relationships to ensure that factors are considered, where appropriate, in decisions relative to standard drawings.

File Under Phase III

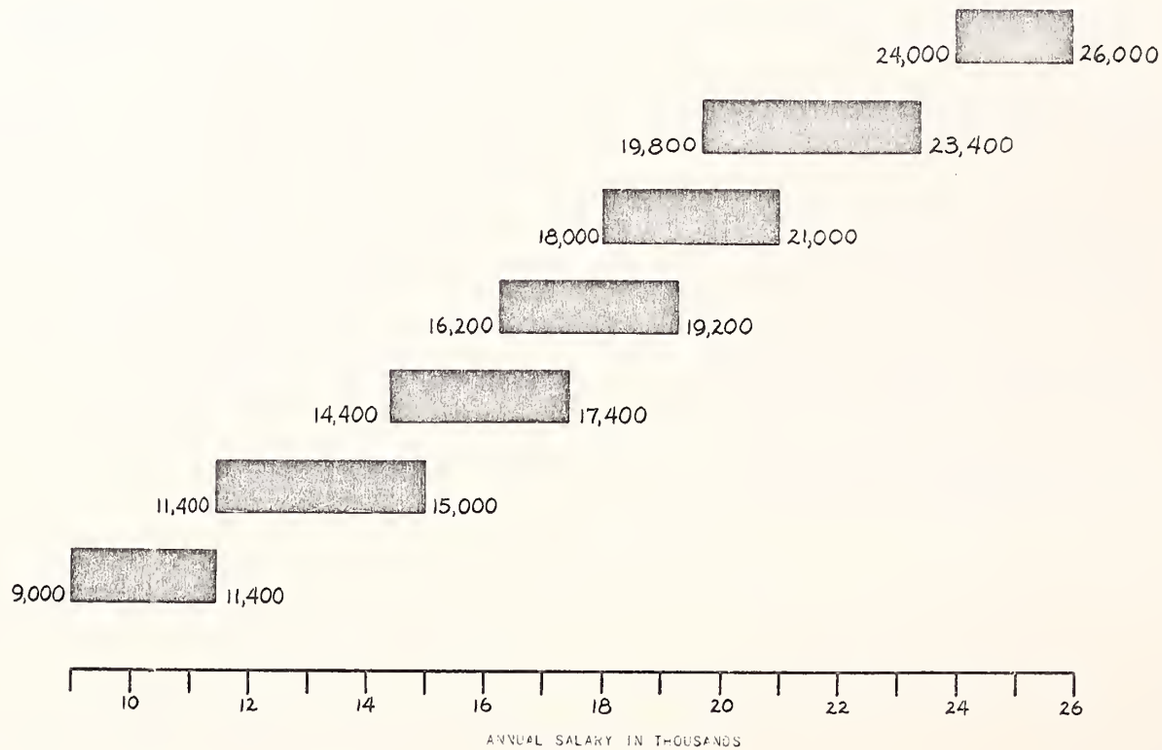
PERSONNEL CLASSIFICATION AND SALARY PLAN

MONTANA DEPARTMENT OF HIGHWAYS

ENGINEER SALARY PLAN

JUNE 1971

CLASSIFICATION	
CHIEF ENGINEER	24,000 – 26,000
MANAGEMENT ENGINEER	19,800 – 23,400
ADMINISTRATIVE ENGINEER	18,000 – 21,000
EXECUTIVE ENGINEER	16,200 – 19,200
SENIOR ENGINEER	14,400 – 17,400
PROJECT ENGINEER	11,400 – 15,000
ENGINEER	9,000 – 11,400

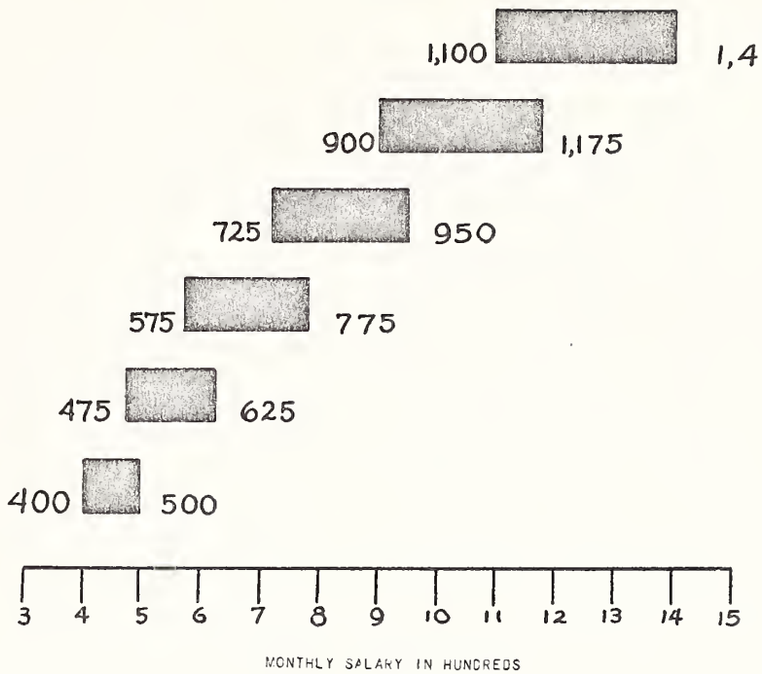


MONTANA DEPARTMENT OF HIGHWAYS

TECHNICIAN SALARY PLAN

JUNE 1971

CLASSIFICATION	
SENIOR MANAGER	1,100 – 1,400
PROJECT MANAGER	900 – 1,175
SENIOR TECHNICIAN	725 – 950
TECHNICIAN III	575 – 775
TECHNICIAN II	475 – 625
TECHNICIAN I	400 – 500



SUMMARY DEFINITIONS OF THE CLASSIFICATIONS IN THE PROPOSED CLASSIFICATION PLAN FOR ENGINEERS AND TECHNICIANS

CLASSIFICATION TITLE	SUMMARY DEFINITION
Chief Engineer	Directs the total Department activity within the framework of law, Commission plans and policies and budgets; recommends long-range highway system improvements based on needs and finances, adopts basic engineering policies and standards and provides continuing direction to engineering work underway.
Management Engineer	Develops long-range highway system improvement programs in such areas as needs and finances, preconstruction development, materials quality control, construction and maintenance; plans and organizes Department functions as necessary to implement adopted programs; reviews and approves, rejects or recommends exceptions to policies and standards.
Administration Engineer	Organizes manpower and equipment, adopts operating policies, develops systems and procedures, and provides administrative direction to such activities as the Bureau of Road Design or the Bureau of Bridge Design.
Executive Engineer	Provides day-to-day direction to programs underway, always in compliance with operational policies and standards; reviews and makes recommendations on organization, system and procedure changes as necessary effectively to execute adopted programs.
Senior Engineer Senior Manager	Supervises project level personnel, making adjustments in manpower, equipment and schedules within assigned projects as necessary to insure an overall balance between work loads and performance capabilities; serves as an authoritative specialist subject to administrative but little technical direction and review.

CLASSIFICATION TITLE	SUMMARY DEFINITION
Project Engineer Project Manager	Initiates, controls and completes undertakings within a carefully defined framework of project objectives, plans, specifications, staffing, schedules and budgets; makes judgemental decisions within project guidelines, but submits recommendations to higher authority on matters not in compliance with established controls.
Engineer	Performs assistant project level work as necessary to the development of project management capability; usually works with project level personnel who have demonstrated capabilities to develop project managers.
Senior Technicians	Supervises major segments of project activities under the control of project level personnel.
Technician III Technician II Technician I	Performs technical work within individual capabilities as assigned.

CLASSIFICATION STATEMENT

CHIEF ENGINEER

Summary Definition

Serves as the Chief Engineering Officer of the Department and directs the total Department activity within the framework of law, Commission plans, policies and budgets; recommends long-range highway system improvements based on needs and finances, adopts basic engineering policies and standards, and provides continuing direction to engineering work underway.

RESPONSIBILITIES UPWARD

Reports system needs and finances.

Recommends long-range program.

Recommends current (2 to 5) years program.

Recommends legislation, basic Department policies and Department manpower plan.

RESPONSIBILITIES DOWNWARD

Provides guidance and direction in the development of long-range and current highway improvement programs and management recommendations.

Provides general engineering objectives and schedules.

Provides basic engineering policies and standards and makes final decision on exceptions.

MINIMUM QUALIFICATIONS

Registration as a professional engineer in the State of Montana
AND
The capability to manage, with only basic direction, a large engineering organization with the scope of programs and complexities of operations of that of the Montana Department of Highways
AND
Three years of experience at the mangement, administrative or executive levels of a complex engineering organization.

CLASSIFICATION STATEMENT

MANAGEMENT ENGINEER

Summary Definition

Develop long-range highway system improvement programs in such areas as needs and finances, preconstruction development, materials quality control, construction and maintenance; plans and organizes Department functions as necessary to implement adopted programs; reviews and approves, rejects or recommends exceptions to policies and standards.

RESPONSIBILITIES UPWARD

Reports results of highway needs and finance studies.

Reports results of highway management studies.

Recommends long-range and current (2 to 5) years programs.

Recommends manpower management program based on long-range and current needs.

Recommends changes in the overall organization of the engineering function.

RESPONSIBILITIES DOWNWARD

Provide long-range and current program assignments, together with major schedule dates, policies, standards, budgets and other control data.

Provide assistance on matters that, unless resolved, will result in non-attainment of Department objectives, programs and schedules.

MINIMUM QUALIFICATIONS

Demonstrated capability to plan, organize, direct and control a major engineering section -- preconstruction or operation -- of the Montana Department of Highways in accordance with the personnel classification plan
AND
Registration as a professional engineer in the State of Montana
AND
Three years of progressively responsible experience at the Administrative, Executive and/or Senior levels of an engineering organization comparable in complexities to the Montana Department of Highways.

CLASSIFICATION STATEMENT

ADMINISTRATIVE ENGINEER

IN

PRECONSTRUCTION DIVISION

Summary Definition

Administrative Engineers organize manpower and equipment, adopt operating policies, develop systems and procedures and provide administrative direction to the Bureau of Road Design or the Bureau of Bridge Design.

RESPONSIBILITIES UPWARD

Report operational programs, schedules, organizations, policies and standards adopted to carry out Department objectives, programs and schedules.

Report exceptions to received policies, schedules and standards.

Report operational progress.

Report future manpower, equipment, budget and other needs.

RESPONSIBILITIES DOWNWARD

Develop operation organization in terms of work load and the relationships between work load and the staffing pattern.

Adopt operational policies.

Adopt systems and procedures.

Establish production schedules.

Evaluate organizational performances.

Manage personnel and training program.

Insure that policy implementation in operation are consistent with the same and similar implementations in other operations.

Establish working relationships with other operational and organization units.

Establish and maintain appropriate relationships between operational and other government agencies, industry and the public.

MINIMUM QUALIFICATIONS

Demonstrated capability to effectively manage a major bureau of the Montana Department of Highways within the policy and program direction of top management
AND
Registration as a professional engineer in the State of Montana
AND
Three years of progressively responsible experience at the Executive, Senior and/or Project levels of an engineering organization.

CLASSIFICATION STATEMENT

EXECUTIVE ENGINEER

IN

PRECONSTRUCTION DIVISION

Summary Definition

Executive Engineers provide day-to-day direction to programs underway, always in compliance with operational policies and standards; they review and make recommendations on organization, system and procedure changes as necessary effectively to execute adopted programs.

RESPONSIBILITIES UPWARD

Report exceptions to operational policies, standards, procedures, staffing patterns and budget schedules.

Report status of operational activities underway.

Report needs for new agreements, legal assistance, specialist engineer assistance and comparable needs from other functions and agencies.

Report organizational performances and evaluations of individual performances.

RESPONSIBILITIES DOWNWARD

Develop project assignments and continuing individual responsibilities for Senior level personnel.

Develop appropriate staffing patterns in terms of work loads and the numbers and types of persons needed to accomplish the work load.

Provide operational policies, standards, schedules and relationships.

Make decisions and/or obtain decisions from higher authority, on exceptions to policies, standards, schedules and similar items.

Authorize the hiring and placing of manpower, the purchase of budgeted equipment and the performance of all work that meets the requirements of the operational plan.

Provide evaluations of performances.

MINIMUM QUALIFICATIONS

Demonstrated capability to make judgmental decision in the initiation, conduct and completion of major operational assignments
AND
Demonstrated capability to execute road preconstruction plans and programs
AND
Registration as a Professional Engineer in Montana
AND
Two years of progressively responsible experience at the Senior and/or Project Engineer levels in an engineering organization whose activities are directly related to the proposed assignments.

CLASSIFICATION STATEMENT

SENIOR ENGINEER
SENIOR MANAGER

IN

PRECONSTRUCTION DIVISION

Summary Definition

Senior Engineers and Senior Managers supervise project level personnel; they make adjustments in manpower, equipment and schedules within assigned projects as necessary to insure an overall balance between work loads and performance capabilities; they serve as an authoritative specialist subject to administrative but little technical direction and review.

RESPONSIBILITIES UPWARD

Report the initiation of projects, the general progress of each project and the completion of each project.

Report exception to policies, standards, schedules, contract terms and similar items; submit recommended changes or administrative action to higher management; report administrative actions initiated.

Evaluate work done, work status, organization performances and individual performances.

Recommend changes in or exceptions to operational policies, standards and procedures.

RESPONSIBILITIES DOWNWARD

Provide guidance, assistance, direction and coaching to project level personnel.

Review status of each project, potential for meeting adopted schedules, manpower needs in relation to manpower assigned, adequacy of project supervision and control, and the need for specialized guidance or senior engineer assistance; allocate manpower based on these considerations.

Report and interpret management decisions on manpower, equipment, schedules, budgets and other requests.

MINIMUM QUALIFICATIONS

SENIOR ENGINEER - Demonstrated capability to manage numerous projects and project supervisors simultaneously
AND
Three years of successful experience at the project level
OR
A masters or doctorate degree in a field directly related to the types of assignments to be made.

SENIOR MANAGER - Demonstrated capability to manage numerous projects and project supervisors simultaneously
AND
Three years of successful experience at the project level.

CLASSIFICATION STATEMENT

PROJECT ENGINEER
PROJECT MANAGER

IN

PRECONSTRUCTION DIVISION

Summary Definition

Project Engineers and Project Managers initiate, control and complete undertakings within a defined framework of project objectives, specifications, staffing, standards, schedules and budgets; make judgemental decisions within project guidelines but submit recommendations to higher authority on matters not in compliance with established controls.

RESPONSIBILITIES UPWARD

Reports project progress.

Reports project completion.

Reports items in exception to project framework; prepares and submits recommendation for problem solution.

Request needed manpower and equipment.

RESPONSIBILITIES DOWNWARD

Provides direction and supervision to one or more projects as assigned.

Analyzes each project in terms of the objectives, requirements for completion and the manpower needed.

Organizes manpower, making best use of the performance capability of each person for doing work and developing additional capability.

Maintain records of work done and other data pertinent to project characteristics and progress.

MINIMUM QUALIFICATIONS

PROJECT ENGINEER - Demonstrated capability to manage projects of the unit to which assigned
AND
Six months successful experience as an Engineer.

PROJECT MANAGER - Demonstrated capability to manage projects of the unit to which assigned
AND
Demonstrated capability to perform at least 90 percent of the tasks of the unit to which assigned
AND
Two years successful experience at the Senior Technician level.

CLASSIFICATION STATEMENT

ENGINEER

Summary Definition

Performs assistant project level work as necessary to the development of project management capability; usually works with project level personnel who have demonstrated capabilities to develop project managers.

Work Assignments

Engineers are assigned to project or senior engineers selected for their unique abilities to develop project engineers.

Work performed on these assignments may include anything from clerical tabulation and routine technical tasks to the temporary management of a project -- but each assignment is based on the individual needs of the engineer. A complete understanding of the responsibilities of the project engineer and of the details of work performance essential to the successful completion of a project are essential.

Work performed includes that need to provide experience in several elements of the training set forth below.

Training Assignments

Engineers are given on-the-job training with regard to the following:

A. Orientational elements.

1. Knowledge of Department objectives, needs, finances, programs, basic policies and accomplishments.

2. Knowledge of the general department organization and organization relationships.

3. Knowledge of the functions, organization and basic policies and procedures of the division or district to which the employee is assigned.

4. Knowledge of the relationships between the Department and the Governor, Legislature, Bureau of Public Roads, other states, counties, municipalities, contractors and public.

B. Technical elements.

1. Knowledge of the basic technology of highway planning, design, construction and maintenance.

2. Detailed knowledge of the technology of the operation to which the employee is assigned -- of soils and aggregates, basic sampling and testing, contract plan reading and basic surveying, for example, if the employee is assigned to construction inspection.

3. Detailed knowledge of the written guides and controls over the work performed -- manuals, directives, standards, procedures.

C. Project management elements.

1. Ability to analyze a project in terms of its objectives, the time requirements for completion, the number of personnel needed and the skills of those personnel, and the numbers and types of equipment needed.

2. Ability to set up project records and controls -- systems of files, progress reports and reports of non-compliance with plans, specifications and standards.

3. Ability to organize the project manpower and equipment, making best use of the performance capability available and developing additional capability.

4. Ability to delegate and control elements of the work so that project management attention can be directed at each work element in need of attention.

5. Ability to make judgmental decisions within the framework of approved objectives, standards, schedules, staffing arrangements and budgets.

6. Ability to recognize the need for higher level assistance to change any part of the project framework, and for specialized assistance in making technical decisions within the project framework.

7. Ability to complete the project as planned and approved.

MINIMUM QUALIFICATIONS

Registration in the State of Montana as a professional engineer or possession of an engineer-in-training certificate, or a degree in a directly related engineering field.

CLASSIFICATION STATEMENT

SENIOR TECHNICIAN

IN

PRECONSTRUCTION DIVISION

Summary Definition

Senior Technicians supervise major segments of project activities under the control of project level personnel; make decisions within guidelines set forth by supervisor.

RESPONSIBILITIES UPWARD

Reports exceptions to project controls and standards.

Reports progress and completion on work items.

Requests additional manpower and equipment as needed to complete work items on schedule.

Reports surplus manpower and equipment as they occur.

Reports training needs of employees assigned.

RESPONSIBILITIES DOWNWARD

Supervises major elements of projects.

Supervise total minor projects without project management authority and responsibility.

Provides on-the-job training for subordinate technicians.

MINIMUM QUALIFICATIONS

Demonstrated capability to supervise projects for several days with guidance only on unusual problems
AND
Demonstrated capability to perform at least 65 percent of the tasks of the unit to which assigned
OR
Demonstrated capability to perform all level one, level two and level three activities plus four level four or level five activities.

CLASSIFICATION STATEMENT

TECHNICIAN III
TECHNICIAN II
TECHNICIAN I

IN

PRECONSTRUCTION DIVISION

Summary Definition

Performs technical work within individual capability as assigned.

RESPONSIBILITIES UPWARD

Reports work performed, status of work underway and situations needing higher level attention.

Reports assignments received that cannot be carried out for lack of data, assistance or equipment.

RESPONSIBILITIES DOWNWARD

Perform technician level work as assigned.

Takes training to develop improved capability.

MINIMUM QUALIFICATIONS

TECHNICIAN III - Demonstrated capability to perform at least 35 percent of the tasks of the unit to which assigned
OR
Demonstrated capability to perform all level one and level two activities plus three level three or four activities.

TECHNICIAN II - Demonstrated capability to perform at least 10 percent of the tasks of the unit to which assigned
OR
Demonstrated capability to perform all level one activities and two level two or level three activities.

TECHNICIAN I - At least 18 years of age
Good personal record
Aptitude, interest and physical capabilities consistent with the work.

PHASE III

CONDITIONS OF EMPLOYMENT

CONDITIONS OF EMPLOYMENT SURVEY

SUMMARY STATEMENTS

HOURS IN REGULAR WORK WEEK

Well over three fourths of employers have 40 hour work weeks for engineering and technical employees.

The Highway Department has a 40 hour week.

OVERTIME PAYMENTS

Technical personnel are paid time and one-half by 80 percent of the employers. Professional personnel are paid time and one-half by 35% of employers.

The Highway Department pays time and one-half to technical personnel up through the G-17 level. Higher level technician employees receive monthly overtime payments at standard rates. Professional employees receive no overtime pay.

HOURS WORKED

Fifty six percent of technicians in business and industry work more than 100 hours per year. Seventy one percent work more than 50 hours per year. Seventy three percent of the professionals work more than 50 hours per year.

Highway Department technicians in Helena rarely work overtime while the field technicians average more than 50 hours per year.

HOLIDAYS

In business and industry 95 percent of employers provide paid holidays. The average number provided is 7.

Highway employees receive 10 paid holidays per year plus election days and other holidays declared by the Governor.

HEALTH AND LIFE INSURANCE

Over 90 percent of employers provide some type of health insurance plan for their employers. The average employer participation if $22.00 per month per employee.

About half of the employers provide life insurance plans -- usually as part of the health plan.

The Highway Department provides group health and life insurance coverage for its employees. The Department's current contribution to costs is $7.50 per month. This contribution will increase to $10.00 per month effective July 1, 1971.

PAID VACATIONS

Paid vacations are provided by ninety one percent of employers. Those that provide paid vacations are divided between constant amounts regardless of seniority and graduated amounts based on length of service.

The Highway Department provides paid vacation on a sliding scale -- 15 days per year for the first 10 years of service and ranging up to 24 days per year for over 20 years of service.

SICK LEAVE

Paid sick leave is provided by 84 percent of employers. Some employers use graduated scales based on length of service -- some use the flat rate regardless of seniority. A significant number -- 34 percent -- do not use a schedule for accrual or use of sick leave.

The Highway Department provides 12 days per year paid sick leave with unlimited accumulation provisions.

RETIREMENT

Retirement plans in addition to Social Security are provided by approximately 40 percent of employers. The average employer contribution is 7 percent of salary.

Highway Department employees are covered by Social Security and the Public Employees Retirement System. Department participation currently is 4.3 percent of salary and is scheduled to reach 5.2 percent by July 1, 1975.

BONUS PAYMENTS

About half of the private (non-government) employers provide bonuses for some or all of their employees. The average bonus payments to technicians is $540 per year. The average bonus payments to professionals is $1,240 per year.

No bonuses are paid to Highway Department employees.

CONDITIONS OF EMPLOYMENT SURVEY

FINDINGS

LENGTH OF WORK WEEK

Existing Conditions -- Conditions of Employment Survey

The regular hours of work adopted by selected employers range from a low of 25 hours per week to a high of 50 hours per week.

Seventy-three percent of the participating employers have all of their employees working a 40-hour week. Twenty-seven percent utilize various length work weeks for different types of employees and employment situations.

Existing Conditions -- Montana Highway Commission

The regular work week for all highway employees is 40 hours.

FIGURE I

LENGTH OF WORK WEEK

BY TYPE OF EMPLOYEE

CONDITIONS OF EMPLOYMENT SURVEY

	Percent of Employers		
Type of Employee	Less than 40 hrs./wk.	40 hrs./wk.	Over 40 hrs./wk.
Clerical and Office	7	84	9
Technical and Field		89	11
Professional		82	18

MONTANA HIGHWAY COMMISSION

Clerical and Office	X
Technical and Field	X
Professional	X

OVERTIME

Existing Conditions -- Conditions of Employment Survey

Most of the employers provide premium rates of pay for overtime work. Some employers plan overtime as part of their regular work conditions while other employers utilize overtime only during periods of heavy work load and emergency situations. Still other employers manage their operations in ways that eliminate overtime completely.

Existing Conditions -- Montana Highway Commission

Present policy authorizes overtime pay only for employees at grade G-17 and below. The rate of pay is time and one-half for hours in excess of forty per week and double time and one-half for work on holidays.

While policy does not authorize overtime for grade-19 and above, in actual practice overtime pay is granted to employees in the Preconstruction Division up to and including grade-23 (Designer III).

Field construction personnel in grades 19, 21, and 23 are compensated for extra work by flat monthly overtime allowances at the following rates:

G-19 (Instrumentman) ..... $35/Mo.
G-21 (Resident Engineer I) ..... $40/Mo.
G-23 (Resident Engineer II) ..... $45/Mo.

The above allowances are received for the entire twelve months of the year.

Our existing practices and policy on overtime pay may be revised extensively as the result of the passage of House Bill No. 338 by the 42nd Legislature.

H.B. 338 says in part under Section 3, paragraph (b), "No employer shall employ any of his employees for a work week longer than forty (40) hours, unless such employee receives compensation for his employment in excess of forty (40) hours in a work week at a rate of not less than one and one-half times the hourly rate at which he is employed".

DESIGN MANAGEMENT PROJECT REVIEW

AGENDA

September 7, 1971

1. Personnel Classification and Salary System (Stapleton)
2. Training Program (Stapleton)
3. Organization (Stapleton)
4. Scheduling and Evaluation System (Shaw)
5. Project Status (Shaw)

PERSONNEL CLASSIFICATION AND SALARY SYSTEM

1. OBJECTIVES

+ TO DEVELOP A PERSONNEL CLASSIFICATION PLAN BASED ON (1) THE CHARACTERISTICS OF THE WORK TO BE DONE, AND (2) THE KNOWLEDGES, SKILLS AND ABILITIES REQUIRED TO PERFORM THE WORK.

+ TO DEVELOP A SALARY PLAN BASED ON THE PREVAILING TERMS OF EMPLOYMENT AND PREVAILING .... WAGE IN THE OPEN MARKET FOR WORK ACCOMPLISHED.

+ TO BASE SALARY INCREASES ON JOB PERFORMANCE AND EMPLOYEE EVALUATION

+ TO IMPLEMENT THE CLASSIFICATION AND SALARY PROGRAM WITHIN THE LIMITS OF EXISTING FUNDS.

CLASSIFICATION STATEMENT

TECHNICIAN III
TECHNICIAN II
TECHNICIAN I

IN

PRECONSTRUCTION DIVISION

Summary Definition

Performs technical work within individual capability as assigned.

RESPONSIBILITIES UPWARD

Reports work performed, status of work underway and situations needing higher level attention.

Reports assignments received that cannot be carried out for lack of data, assistance or equipment.

RESPONSIBILITIES DOWNWARD

Perform technician level work as assigned.

Takes training to develop improved capability.

MINIMUM QUALIFICATIONS

TECHNICIAN III - Demonstrated capability to perform at least 35 percent of the tasks of the unit to which assigned
OR
Demonstrated capability to perform all level one and level two activities plus three level three or four activities.

TECHNICIAN II - Demonstrated capability to perform at least 10 percent of the tasks of the unit to which assigned
OR
Demonstrated capability to perform all level one activities and two level two or level three activities.

TECHNICIAN I - At least 18 years of age
Good personal record
Aptitude, interest and physical capabilities consistent with the work.

ACTIVITIES BY LEVEL OF DIFFICULTY

LEVEL	ROAD DESIGN	TRAFFIC
1	Plot cross-sections Compute areas Plot mass diagrams Inking and tracing Plot construction limits Prepare ROW linens	Prepare plan view of roadway Prepare guide sign plan sheet Code computer inputs Prepare title sheet or summary sheets Operate remote terminal
2	Plot survey data Compute grade lines Plot drainage Prepare displays & illus. Compute earthwork Code basic computer inputs Extend estimates and quantities Prepare utility plans Determine theoretical crush-down Develop standard city agreements Prepare bid summaries	Plot data from sketch Determine layout of standard control devices Prepare speed zone folders Prepare crash diagrams
3	Check notes preparatory to plotting Template cross-sections Design clearing and grubbing Compute ROW areas of taking Compute final quantities Cross-check road & bridge plans Prepare ROW sepias Review consultant agreements Prepare engineers estimate Prepare proposal package Prepare for letting Conduct letting & evaluate bids	Develop cost estimates Prepare or check quantity sheets
4	Design contour grading Design miscellaneous features Design fencing Check & interpret computer runs Design ROW limits Determine soil support values Prepare modified estimate Compile & review standard drawings	Review approach permits Develop phase diagrams Design guide and unusual signs Develop signal and lighting layout Prepare progress reports

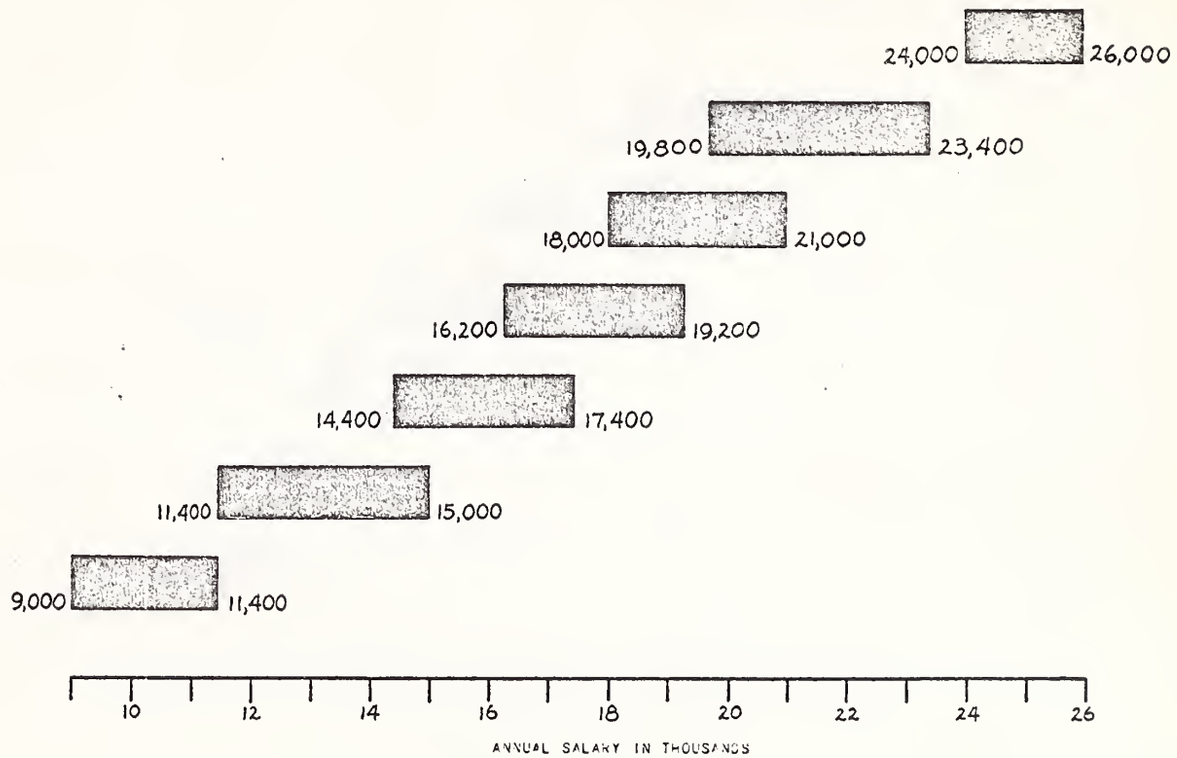
LEVEL	ROAD DESIGN	TRAFFIC
5	Design typical sections Design alignment & grade Design intersections, inter-changes, etc. Design drainage Prepare preliminary estimates Write preliminary special provisions Code complex computer inputs Interpret and plot property lines Check & review plans Design structural sections Select materials sources Develop contract bid item list Develop special city agreements Write final special provisions Present project to Board of Review Prepare reports + Supporting Requirements	Check electrical design plans Develop timing schedules Determine need for signalization Prepare preliminary special provisions Design traffic facilities related to roadway geometrics Determine adequacy of existing facilities Check plans Develop wiring layout Prepare or check design of control structures + Supporting Requirements

MONTANA DEPARTMENT OF HIGHWAYS

ENGINEER SALARY PLAN

JUNE 1971

CLASSIFICATION	
CHIEF ENGINEER	24,000 – 26,000
MANAGEMENT ENGINEER	19,800 – 23,400
ADMINISTRATIVE ENGINEER	18,000 – 21,000
EXECUTIVE ENGINEER	16,200 – 19,200
SENIOR ENGINEER	14,400 – 17,400
PROJECT ENGINEER	11,400 – 15,000
ENGINEER	9,000 – 11,400

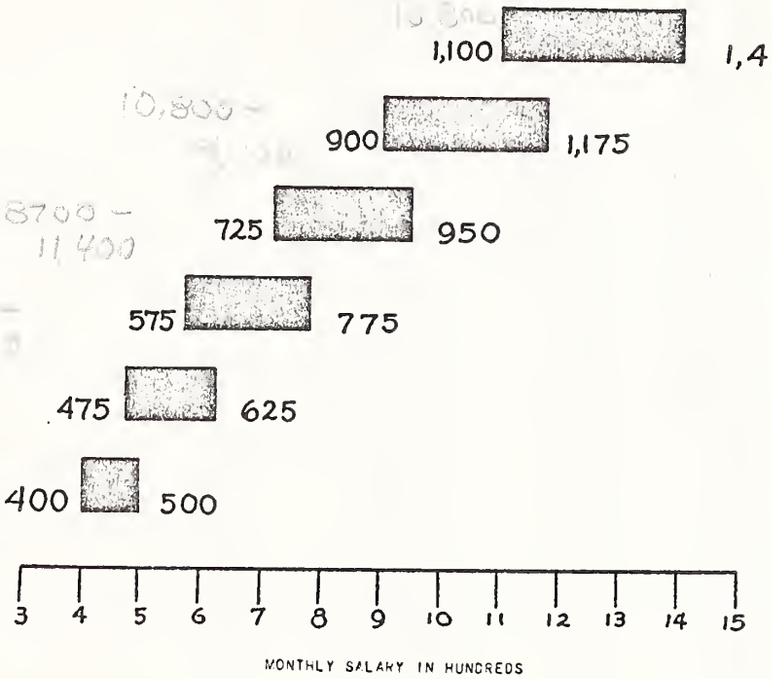


MONTANA DEPARTMENT OF HIGHWAYS

TECHNICIAN SALARY PLAN

JUNE 1971

CLASSIFICATION	
SENIOR MANAGER	1,100 – 1,400
PROJECT MANAGER	900 – 1,175
SENIOR TECHNICIAN	725 – 950
TECHNICIAN III	575 – 775
TECHNICIAN II	475 – 625
TECHNICIAN I	400 – 500



TRAINING PROGRAM

1. OBJECTIVES

+ TO IDENTIFY THE TRAINING-RELATED CHARACTERISTICS OF THE EMPLOYEES TO BE TRAINED.

+ TO IDENTIFY THE PRINCIPAL TRAINING NEEDS OF THE ROAD DESIGN PERSONNEL.

+ TO DEVELOP A PLAN FOR TRAINING THAT BEST WILL PROVIDE THE NEEDED TRAINING WITH THE BEST UTILIZATION OF THE DOLLARS SPENT.

TRAINING NEEDS ANALYSIS REPORT DATED AUGUST 1971.

ROAD DESIGN

COMMON KNOWLEDGE, SKILL AND ABILITY

AND MAJOR ACTIVITY STATEMENTS

Statement Title	Statement Number
Common KSA Statements	
Mathematics One	1
Mathematics Two	2
Mathematics Three	3
Basic Survey Interpretation	4
Advanced Survey Interpretation	5
Plan Reading	6
Basic Drafting	7
Advanced Drafting	8
Manuals Of Reference	9
Major Activity Statements	
Template Cross Sections	10
Code Basic Computer Inputs	11
Code Complex Computer Inputs	12
Prepare Utility Plans	13
Design Typical Sections	14
Design Alignment and Grade	15
Design Intersection, Rest Area, Scale and Interchange Geometrics	16
Design Contour Grading	17
Design Mass Diagram	18
Design Fencing	19

(Continued)

Major Activity Statements (continued)	Statement Number
Design Drainage	20
Design Right-Way Limits	21
Design Miscellaneous Features	22
Write Preliminary Special Provisions	23
Prepare Preliminary Estimates	24
Check and Review Plans	25
Cross Check Structure and Road Plans	26

A TYPICAL COMMON KSA STATEMENT

MATHEMATICS ONE

Knowledge

1. Of the arithemetic used in working with whole, fractional and decimal numbers.

2. Of the procedures followed to convert fractions to decimals and decimals to fractions.

3. Of the rules followed in rounding decimal and fractional numbers.

4. Of the basic rules regarding the "significance of numbers".

Skill

1. In adding machine or calculator operation.

Ability

1. To add, subtract, multiply and divide whole, fractional and decimal numbers accurately and quickly.

2. To calculate percentages.

3. To relate numbers to each other as ratios.

A TYPICAL MAJOR ACTIVITY STATEMENT

DESIGN DRAINAGE

Common KSA Requirements

Mathematics One
Mathematics Two
Mathematics Three
Basic Survey Interpretation
Plan Reading
Basic Drafting
Manuals of Reference

Specific KSA Requirements

Knowledge

1. Of basic hydraulics--pipe Q, Velocity and head.

2. Of interpretation and application of standards -- drainage standards, right-of-way, fill or cover and gauge.

3. Of design standard limitations and solutions for special problems -- cross drainage plan and irrigation.

4. Of engineering evaluations necessary to determine pipe materials and types and locations of facilities.

5. Of soils reports and of the reactions of soils types to materials types.

(Continued)

Skill

None

Ability

1. To visualize flow line and channel changes.

2. To design drainage features to fit topography, run-off ....and existing features.

COMPARISON OF ROAD DESIGN WORK FORCE AND SAMPLE CHARACTERISTICS

Personnel Classification	Total Road Design Force	Sample Characteristics	
		Number Tested	Percent of Total Force
Designer II and III	22	4	18.2%
Detailer I and II, and Designer I	21	4	19.0
Draftsman I, II and III	32	5	15.6
Total	75	13	
Sample Size (In Percent)			17.3%

DISTRIBUTION OF ROAD DESIGN PERSONNEL ACCORDING TO AGE 1/

Personnel Classification	ROAD DESIGN FORCE 2/ Total Number	ROAD DESIGN FORCE 2/ Average Age	SAMPLE CHARACTERISTICS Total Number	SAMPLE CHARACTERISTICS Average Age
Designer III	14	45	1	40
Designer II	8	43	3	42
Designer I	11	45	3	49
Detailer II	1	38	0	
Detailer I	9	39	1	45
Draftsman III	16	42	3	28
Draftsman II	15	25	2	23
Draftsman I	1	20	0	
Total	75		13	
Average Age		39		38

1/ Excludes non-engineering administrative and clerical personnel, and field design personnel.

2/ Based on the manpower inventory taken August 1970.

DISTRIBUTION OF ROAD DESIGN PERSONNEL ACCORDING TO EXPERIENCE[1]

Personnel Classification	ROAD DESIGN FORCE[2]		SAMPLE CHARACTERISTICS	
	Total Number	Average Years Of Experience	Total Number	Average Years Of Experience
Designer III	14	18	1	23
Designer II	8	16	3	18
Designer I	11	13	3	11
Detailer II	1	15	0	
Detailer I	9	11	1	11
Draftsman III	16	11	3	7
Draftsman II	15	2	2	2
Draftsman I	1	1	0	
Total	75		13	
Average Years of Experience		11		11

[1] Excludes non-engineering administrative and clerical personnel, and field design personnel.

[2] Based on the manpower inventory taken August, 1970.

DISTRIBUTION OF ROAD DESIGN PERSONNEL ACCORDING TO EDUCATION [1]

Personnel Classification	ROAD DESIGN FORCE [2]		SAMPLE CHARACTERISTICS	
	Total Number	Average Years Of Education	Total Number	Average Years Of Education
Designer III	14	11	1	12
Designer II	8	14	3	14
Designer I	11	12	3	14
Detailer II	1	12	0	
Detailer I	9	13	1	12
Draftsman III	16	13	3	13
Draftsman II	15	13	2	14
Draftsman I	1	12	0	
Total	75		13	
Average Years of Education		13		13

[1] Excludes non-engineering administrative and clerical personnel, and field design personnel.

[2] Based on the manpower inventory taken August, 1970.

DISTRIBUTION OF ROAD DESIGN PERSONNEL
ACCORDING TO WONDERLIC TEST SCORES

August, 1971

Personnel Classification	Number of Personnel Tested	SCORE DISTRIBTUTION						Average Score
		0 to 6	7 to 11	12 to 17	18 to 23	24 to 29	above 30	
Designer III and II	4				1	2	1	26
Designer I and Detailer I	4			1	2		1	23
Draftsman III and II	5				4	1		22
Total	13	0	0	1	7	3	2	
Total Average Score								23.5

TEST AND EVALUATION RESULTS

TRAINING NEEDS ESTIMATES

Common KSA Statements

KSA Statement	Sample Results: Persons Tested [1]	Sample Results: Percent of Sample	Sample Results: Number Needing Training	Sample Results: Percent of Sample Needing Training	Estimates [2]: Applicable Personnel	Estimates [2]: Persons Needing Training
Mathematics One	13	100%	5	39%	75	30
Mathematics Two	13	100	7	54	75	40
Mathematics Three	6	46	3	50	34	16
Basic Survey Interpretation	13	100	6	46	75	34
Advanced Survey Interpretation	8	62	0	0	46	0
Plan Reading	13	100	4	31	75	24
Basic Drafting	13	100	4	31	75	24
Advanced Drafting	7	54	5	71	40	28
Manuals of Reference	13	100	10	77	75	58

[1] The test group included 13 persons. Less than 13 persons are shown to have been tested on certain KSA's because all individuals in the sample were not required to take all sections.

[2] Based on 75 persons in Road Design. All estimates have been rounded to the nearest even number of personnel to simplify the analysis and to emphasize that the figures are estimates.

TEST AND EVALUATION RESULTS

TRAINING NEEDS ESTIMATES

Computer Utilization Statements

KSA Statement	Sample Results: Persons Tested	Sample Results: Percent of Sample [1]	Sample Results: Number Needing Training	Sample Results: Percent of Sample Needing Training	Estimates [2]: Applicable Personnel	Estimates [2]: Persons Needing Training
Code Basic Computer Inputs	8	62%	6	75%	46	34
Code Complex Computer Inputs	4	31	3	75	24	18

[1] The test group included 13 persons. Less than 13 persons are shown to have been tested on certain KSA's because all individuals in the sample were not required to take all sections.

[2] Based on 75 persons in Road Design. All estimates have been rounded to the nearest even number of personnel to simplify the analysis and to emphasize that the figures are estimates.

TEST AND EVALUATION RESULTS

TRAINING NEEDS ESTIMATES

Right-of-Way and Utility Statements

KSA Statement	Sample Results: Persons Tested[1]	Sample Results: Percent of Sample	Sample Results: Number Needing Training	Sample Results: Percent of Sample Needing Training	Estimates[2]: Applicable Personnel	Estimates[2]: Persons Needing Training
Prepare Utility Plans	3	23%	1	33%	12	4
Design Fencing	3	23	2	67	12	8
Design Right-of-Way Limits	2	15	1	50	12	6

[1] The test group included 13 persons. Less than 13 persons are shown to have been tested on certain KSA's because all individuals in the sample were not required to take all sections.

[2] Based on 12 persons in Road Design. All estimates have been rounded to the nearest even number of personnel to simplify the analysis and to emphasize that the figures are estimates.

TEST AND EVALUATION RESULTS

TRAINING NEEDS ESTIMATES

Design Statements

KSA Statement	Sample Results				Estimates 2/	
	Persons Tested	Percent of Sample 1/	Number Needing Training	Percent of Sample Needing Training	Applicable Personnel	Persons Needing Training
Template Cross Sections	10	77%	6	60%	48	28
Design Typical Sections	6	46	4	67	28	18
Design Alignment and Grade	4	31	0	0	20	0
Design Intersections, Rest Area Scale and Interchange Geometrics	4	31	1	25	20	4
Design Contour Grading	6	46	3	50	28	14
Design Mass Diagram	6	46	3	50	28	14
Design Drainage	6	46	2	33	28	10
Design Miscellaneous Features	6	46	3	50	28	14
Write Preliminary Special Provisions	4	31	3	75	20	14
Prepare Preliminary Estimates	8	62	7	88	40	36
Check and Review Plans	4	31	2	50	20	10
Cross-check Structure and Road Plans	6	46	4	67	28	18

1/ The test group included 13 persons. Less than 13 persons are shown to have been tested on certain KSA's because all individuals in the sample were not required to take all sections.

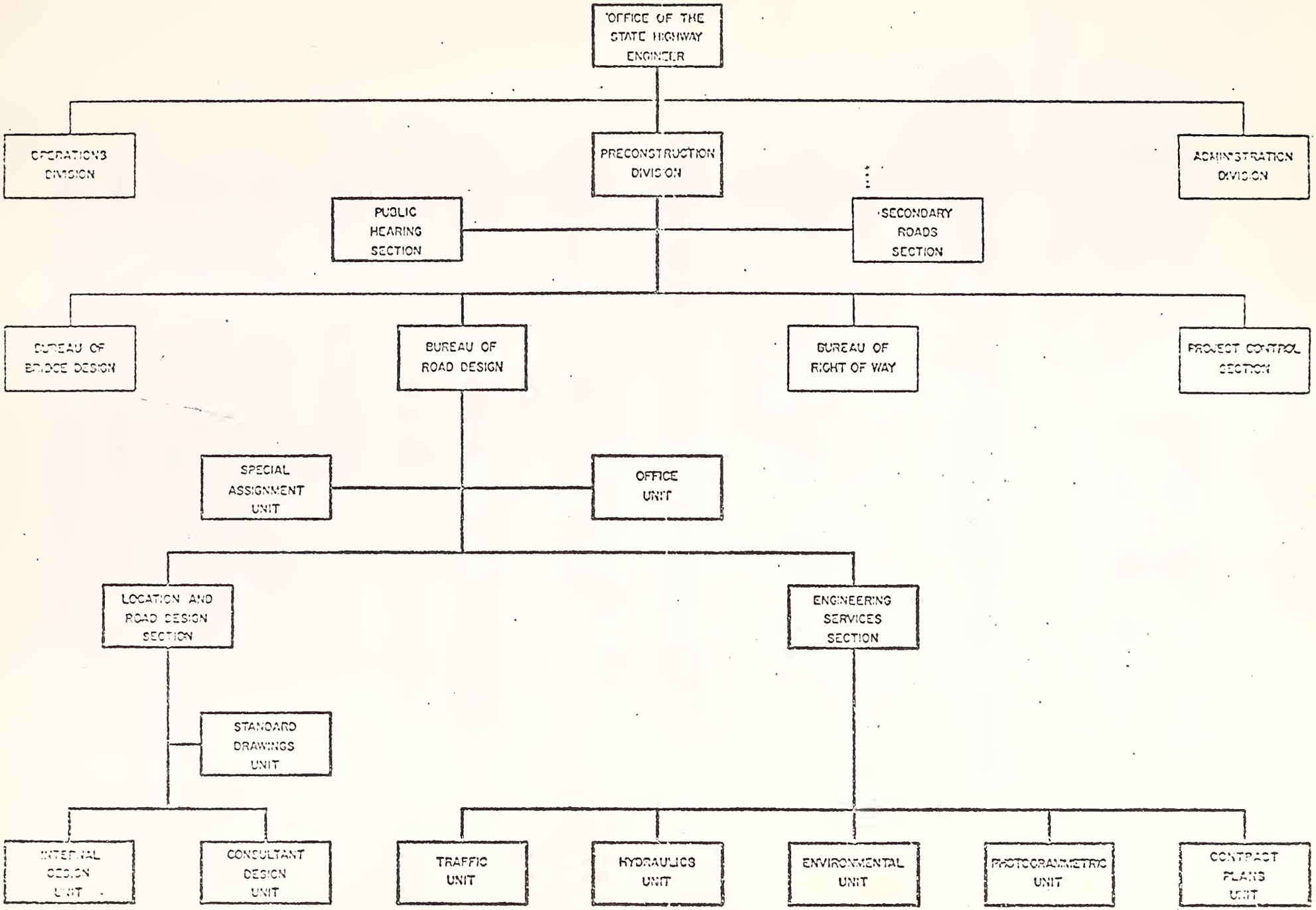
2/ Based on 63 persons in Road Design. All estimates have been rounded to the nearest even number of personnel to simplify the analysis and to emphasize that the figures are estimates.

ORGANIZATION

1. OBJECTIVES

+ TO DEVELOP A FUNCTIONAL ORGANIZATIONAL FRAMEWORK BASED ON THE REQUIREMENTS OF THE WORKLOAD.

+ TO DEVELOP POSITION GUIDES FOR THE KEY POSITIONS IN THE RECOMMENDED ORGANIZATION WHICH DESCRIBE THE FUNCTION, RESPONSIBILITIES AND AUTHORITIES, AND RELATIONSHIPS OF THE POSITION.


OFFICE OF THE STATE HIGHWAY ENGINEER
OPERATIONS DIVISION
PRECONSTRUCTION DIVISION
ADMINISTRATION DIVISION
PUBLIC HEARING SECTION
SECONDARY ROADS SECTION
BUREAU OF BRIDGE DESIGN
BUREAU OF ROAD DESIGN
BUREAU OF RIGHT OF WAY
PROJECT CONTROL SECTION
SPECIAL ASSIGNMENT UNIT
OFFICE UNIT
LOCATION AND ROAD DESIGN SECTION
ENGINEERING SERVICES SECTION
STANDARD DRAWINGS UNIT
INTERNAL DESIGN UNIT
CONSULTANT DESIGN UNIT
TRAFFIC UNIT
HYDRAULICS UNIT
ENVIRONMENTAL UNIT
PHOTOGRAMMETRIC UNIT
CONTRACT PLANS UNIT

CHIEF, BUREAU OF ROAD DESIGN

I. FUNCTION

The Chief, Bureau of Road Design accomplishes the location and design of all highway projects required in the Construction program and administers all design service unit activities including those of Hydraulics, Traffic, Environmental, Photogrammetrics and Contract Plans in accordance with Department and statutory requirements.

II. RESPONSIBILITY AND AUTHORITY

Within the limits of Department policy and in accordance with approved procedures, the Chief, Bureau of Road Design is responsible for and has the authority to perform or cause to be performed the following:

A. Activities

1. Directs or supervises the following subordinate positions:

   a) Supervisor of Location and Road Design Section
   b) Supervisor of Engineering Service Section
   c) Manager of Special Assignments Unit
   d) Manager of Office Unit

2. Implements Department policy and develops recommendations for warranted changes in policy that affect the road design function.

3. Approves procedures in accordance with Department policy for use in the performance of design or design service functions.

4. Participates in the long-range highway planning function, including programming of projects in the Five-Year Plan.

5. Approves project schedules and ensures accomplishment of scheduled objectives.

6. Develops budgets for the Bureau of Road Design and approves expenditures of funds.

7. Approves and implements the planning guidelines for use in planning, programming and scheduling work. Periodically reviews the validity of the values and recommends revisions based on legislative action, Federal Highway Administration requirements, Bureau experience or other appropriate criteria.

8. Approves the training program.

9. Approves standard drawings and standard sheets.

10. Provides for the location, design and engineering, authorization to receive bids and contract negotiations in accordance with statutory requirements.

11. Provides for contracts with consulting firms for the preliminary engineering and design of highways.

12. Provides for the necessary documentation of projects in accordance with statutory regulations, Department policy and Federal Highway Administration requirements.

B. Organization

1. Develops and maintains an effective and economic organization in the Bureau of Road Design.

2. Ensures that all employees in the Bureau of Road Design understand the responsibilities of their positions and that position guides, policies and procedures for the Bureau of Road Design are current and adequate.

3. Delegates authority to subordinates consistent with their duties and abilities.

C. Personnel

1. Provides for the training and development of employees within the Bureau of Road Design.

2. Approves personnel actions affecting subordinates.

3. Approves staffing requirements of the Bureau of Road Design based on workload and optimum manpower utilization and benefit-costs.

4. Provide for performance review and appraisal of subordinates.

III. RELATIONSHIPS

A. With the Administrator, Preconstruction Division --

1. Accounts to him for the direction and execution of responsibilities in the Bureau of Road Design.

2. Advises of significant developments and reviews major programs and plans for the Bureau of Road Design.

B. With the Chief, Bureau of Bridge Design --

1. Coordinates the road design function with him to ensure that road design factors are considered in the design of structure projects.

C. With the Supervisor of the Project Control Section --

1. Coordinates road design matters with him to ensure coordinated efforts toward Department objectives and integration of road design and design service activities with long-range planning activities.

D. With other Divisions, Sections and Districts --

1. Develops and maintains close relationships to ensure that Bureau of Road Design factors are considered, where appropriate, in decisions related to that function.

E. With the Federal Highway Administration, other Agencies, Contractors and Suppliers --

1. Establishes and maintains those relationships which are in the best interest of the Department and are necessary for the accomplishment of his function.

F. With the General Public --

1. Establishes and maintains those relationships which are in the best interest of the Department and are necessary for the accomplishment of his functian .

2. Acts in the capacity as a representative of the State Highway Engineer.

ROAD DESIGN
PROPOSED SCHEDULING
AND EVALUATING (CONTROLLING) SYSTEM

OBJECTIVES

The development of a system which will use work load data, productivity data and activity sequence diagrams so that:

1. Multiple-project work loads can be accomplished with the best time-cost relationships.

2. Management officials can determine in advance the commitments of time and manpower needed to complete a project.

3. Design officials can control the expenditures of time and man hours while work is underway to ensure that resource commitments and completion dates will be met.

DESIRABLE CHARACTERISTICS

1. Simple.

2. Variable crew size.

3. Maximum participation.

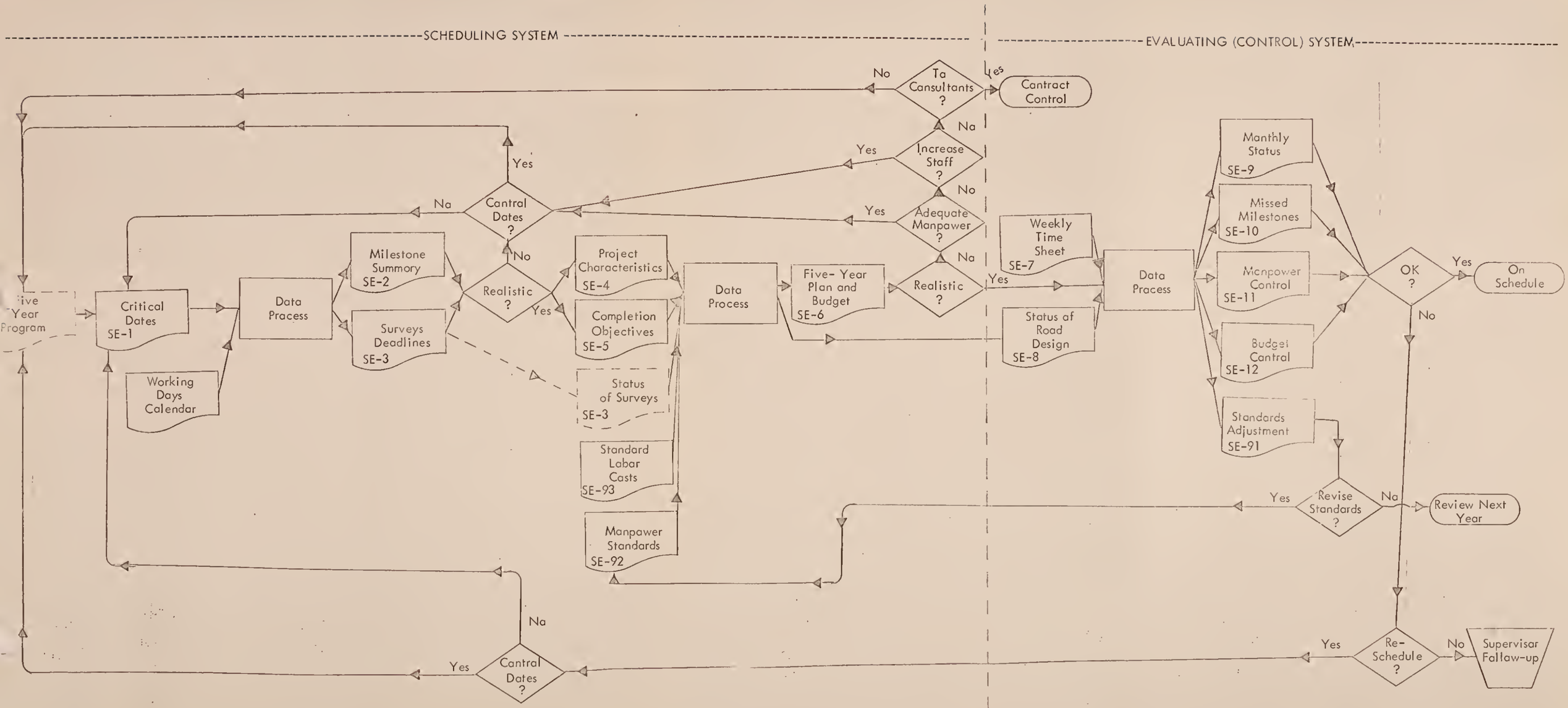
4. Objective oriented.

5. Flexible.

ROAD DESIGN

PROPOSED SCHEDULING

AND EVALUATING SYSTEM



SCHEDULING AND EVALUATING SYSTEM

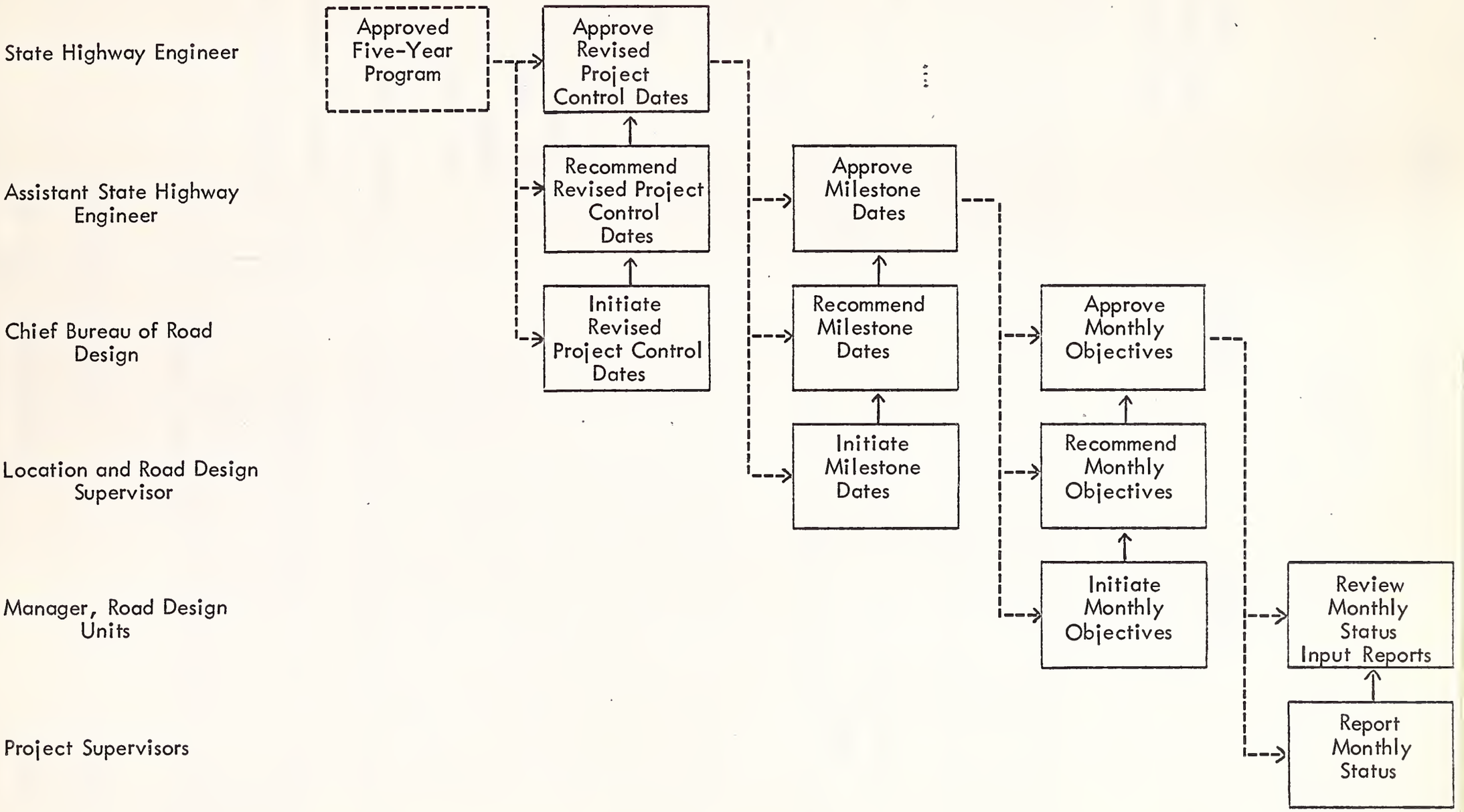
ROUTINE INPUTS

FREQUENCY	Annual, and as rescheduling is necessary	Once, and as project characteristics change	Monthly	Weekly
REPORTS	Critical Dates	Project Characteristics	Status of Road Design	Time Sheet
	Monthly Objectives		Status of Field Design	
	Standards Revision			

SCHEDULING SYSTEM

INPUT REPORTING REQUIREMENT

BY ORGANIZATION LEVEL



CRITICAL DATES ESTABLISHMENT

Project Description:

Number _____ Linear Length _____

Type _____ Location _____

Project Control Dates:	Approved Program	Revised Program
Preconstruction Starts	_____	_____
Contract Letting Date	_____	_____

Revision Justification:

_____

_____

_____

_____

Revision Approved _____ _____

(Chief Engineer) (Date)

****

Road Design Milestone Dates:

PR-1 Approval _____

Recon. Studies and/or Mapping _____

Location Report _____

Complete Field Surveys _____

Complete Planning Report _____

Complete P.P.I.H. Inspection _____

Initial Plans to Right-of-Way _____

Complete F.P.I.H. Inspection _____

Final Plans to Right-of-Way _____

Complete Final Plans _____

Transmit to Contract Plans Section _____

Project Assignments:

Senior Road Design Supervisor _____ _____
(name) (no.)

Project Road Design Supervisor _____ _____
(name) (no.)

Field Survey _____ _____
(District or Division) (no.)

Approvals:

_____ _____
(Road Design Engineer) (date)

_____ _____
(A.S.H.E. - Preconstruction) (date)

_____ _____
(A.S.H.E. - Operations) (date)

EXAMPLE

WORKING DAYS

CALENDAR

1971

Month	Work Days
January	20
February	18
March	23
April	22
May	20
June	21
July	22
August	22
September	21
October	21
November	21
December	21

1972

1973

1974

1975

ROAD DESIGN

MILESTONE SUMMARY

BY PROJECT SUPERVISOR

Senior Supervisor _____ Report Date _____

Project Supervisor _____

Project Description Number Type --- Location Length	Milestone Element	Complete Date	Working Days In Period	Current Year (By Month) JFMAMJJASOND	Current Year +1 (By Month) JFMAMJJASOND	Current Year +2 (By Month) JFMAMJJASOND	Current Year +3 (By Quarter) 1 2 3	Current Year +4 (By Quarter) 1 2 3

COMPLETION DEADLINES
FIELD OR AERIAL SURVEYS
and
SOILS AND GEOLOGICAL RECOMMENDATIONS

Division _____ Program Date _____

Month Ended _____ Revised _____

Project Description				Scheduled Completion		Actual Completion	
Number	Type	Location	Length	PR-1 Approval	Field and Soils Surveys	Field Survey	Soils Survey

PROJECT CHARACTERISTICS

Project Number _____

System: Interstate ☐ Primary ☐ Secondary ☐ Urban ☐

Length:

Project Linear Length	_____	miles
Add:		
Length of Split Alignment for Multi-Lane Projects	_____	miles
Total Adjusted Road Design Length	_____	miles

Culture and Terrain:

Rural Irrigated	_____	miles
Mountainous and Valley	_____	miles

Special Features:

Interchange(s)	_____	number
Weigh Station(s)	_____	number
Rest Area(s)	_____	number
Major Intersection(s)	_____	number
Frontage Road(s)	_____	miles
Detour Road(s)	_____	miles

ROAD DESIGN

COMPLETION OBJECTIVES

BY MILESTONES AND WORK ACTIVITY

Project Number _____

Project Supervisor _____ Date Scheduled _____

Senior Supervisor _____

MILESTONES AND WORK ACTIVITIES		SCHEDULED PERCENT COMPLETION BY MILESTONE AND WORK ACTIVITY				
		Current Year (By Month)	Current Year +1 (By Month)	Current Year +2 (By Quarter)	Current Year +3 (By Quarter)	Current Year +4 (By Quarter)
Name	Code	J F M A M J J A S O N D	J F M A M J J A S O N D	1 2 3 4	1 2 3 4	1 2 3 4

STANDARD LABOR COSTS

Date Prepared August 10, 1971

Date Effective Example

Code	Personnel Classification Title	Hourly Rate
11	Technician I	$3.17
12	Technician II	3.23
13	Technician III	3.91
14	Senior Technician	4.35
15	Project Manager	5.73
16	Senior Manager	6.85
21	Engineer	4.60
22	Project Engineer	5.87
23	Senior Engineer	7.25

FIVE YEAR

MANPOWER BUDGETING REPORT

ROAD DESIGN

SE

---- ACTUAL ---- ---------- ESTIMATED ----------

PROJECT NUMBER	Estimated Total Labor		Total to 6-30 PY		Current Fiscal Year		C.Y. +1		C.Y. +2		C.Y. +3		C.Y. +4	
	Man Hours	Costs	Man Hours	Costs	Man Hours	Costs	Man Hours	Costs	Man Hours	Costs	Man Hours	Costs	Man Hours	Costs
TOTAL														
RECAP:														
Tech I														
Tech II														
Sr. Engr.														
TOTAL														

WEEKLY TIME SHEET

Name _____ Man No. [ ]

Personnel Classification _____ Class No. [ ]

Period Beginning Saturday [ ] [ ] [ ]
Mo. Day Year

Project Number	Activity Code	TIME CHARGED IN HOURS							Total Regular	Total Overtime	Total Hours
		Sat.	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.			
TOTAL HOURS											

MONTHLY OBJECTIVES

AND STATUS OF ROAD DESIGN

Project Number _____ Month Reported _____

Project Supervisor _____

MILESTONES AND WORK ACTIVITIES		SCHEDULED AND ACTUAL PROGRESS BY PERCENT OF ACTIVITY COMPLETED										
		Current Month		Current Mo +1		Current Mo +2		Current Mo +3		Cur Mo + 4	Cur Mo + 5	
Name	Code	Sched.	Act.	Sched.	Act.	Sched.	Act.	Sched.	Act.	Sched.	Sched.	Remarks

SE

ROAD DESIGN

MONTHLY STATUS REPORT

Period Ended _____

PROJECT IDENTIFICATION				Letting Date	MILESTONES STATUS									
					Planning Report		P.P.I.H.		F.P.I.H.		Final Plans		To Contract Pla	
Number	Length	Type	Location		Scheduled Date	% Complete	Scheduled Date	% Complete	Scheduled Date	% Complete	Scheduled Date	% Complete	Scheduled Date	% Comple

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ROAD DESIGN

MONTHLY EXCEPTION REPORT

MISSED MILESTONE DATES

Period Ended _____

Project Number/Length and Type	----- SUPERVISION ----	---------- MISSED MILESTONE ----------				Remarks
	Senior/Project	Completion Event	Scheduled Complete Date	Days Behind Schedule	Percent Man Hours Used	

* Based on hou[illegible]o date

MONTHLY ROAD DESIGN
MANPOWER CONTROL REPORT

Senior Supervisor _____ Period Ended _____

Project Number	ESTIMATED TOTAL MAN HOURS		MAN HOURS TO DATE			ESTIMATED MAN HOURS REQUIRED						
	Original	Revised *	Estimate	Actual	% of Est.	Next Month	Next Month + 1	Next Month + 2	Next Month + 3	Next Month + 4	Next Month + 5	Balance to Complete
TOTAL												

RECAP BY PERSONNEL CLASS.

Tech I												
Tech II												
Tech III												
Sr. Tech												
Proj. Supv.												
TOTAL												

MONTHLY ROAD DESIGN

BUDGET ANALYSIS REPORT

Unit _____ Period Ended _____

Percent of Working Time Elapsed _____

Personnel Classification	FISCAL YEAR BUDGET		TOTAL TO DATE		SCHEDULED BALANCE TO COMPLETE		REVISED FISCAL YEAR ESTIMATE	
	Man Hours	Dollars	Man Hours	% of Budget	Man Hours	Full-time Equivalent	Man Hours	Dollars
Technician I								
Technician II								
Technician III								
Senior Technician								
Project Supervisor								
TOTAL								

EXAMPLE
MANPOWER STANDARDS

	ACTIVITY		
	Planning Report	Master Linens and Computer Inputs	Special Feature Layout Design
Unit of Measure	Project	Mile	Feature
Man Hours per Unit	52	16	81
ADJUSTMENTS:			
Interstate	+ 50%	--	--
Primary	--	--	--
Secondary	--	--	--
Urban	--	100%	--
Irrigated	--	--	--
Mountainous	+ 10%	+ 25%	--
Interchanges	--	--	--
Weigh Stations	--	--	--
Rest Areas	--	--	+ 50%
Major Intersections	--	--	- 50%
Frontage Roads	--	--	--
Detour Roads	--	--	--
MAN HOURS DISTRIBUTION BY PERSONNEL CLASSIFICATION:			
Technician I	--	50%	--
Technician II	--	50%	--
Technician III	--	--	--
Senior Technician	4%	--	70%
Project Supervisor	96%	--	30%

EXAMPLE
STANDARDS ADJUSTMENT
REPORT

Activity Planning Report Report Period 1971

Unit Of Measure Project

	CURRENT	ACTUAL			
		Range			
	STANDARD	From	To	Weighted Average	No. of Projects
Man Hours Per Unit	52	20	240	63	85
ADJUSTMENTS:					
Interstate	78 (+50%)	55	240	73	21
Primary	52	20	175	60	29
Secondary	52	40	69	55	18
Urban	52	50	105	80	37
Irrigated	52	40	69	55	40
Mountainous	57 (+10%)	75	200	100	19
Interchanges	--	--	--	--	--
Weigh Stations	--	--	--	--	--
Rest Areas	--	--	--	--	--
Major Intersections	--	--	--	--	--
Frontage Road	--	--	--	--	--
Detour Road	--	--	--	--	--
MAN HOURS DISTRIBUTION BY PERSONNEL CLASSIFICATION:					
Technician I	--	--	20%	--	
Technician II	--	--	30	2%	
Technician III	--	--	35%	5%	
Senior Technician	4%	5%	80%	10%	
Project Supervisor	96%	25%	100%	83%	

SUMMARY FILE

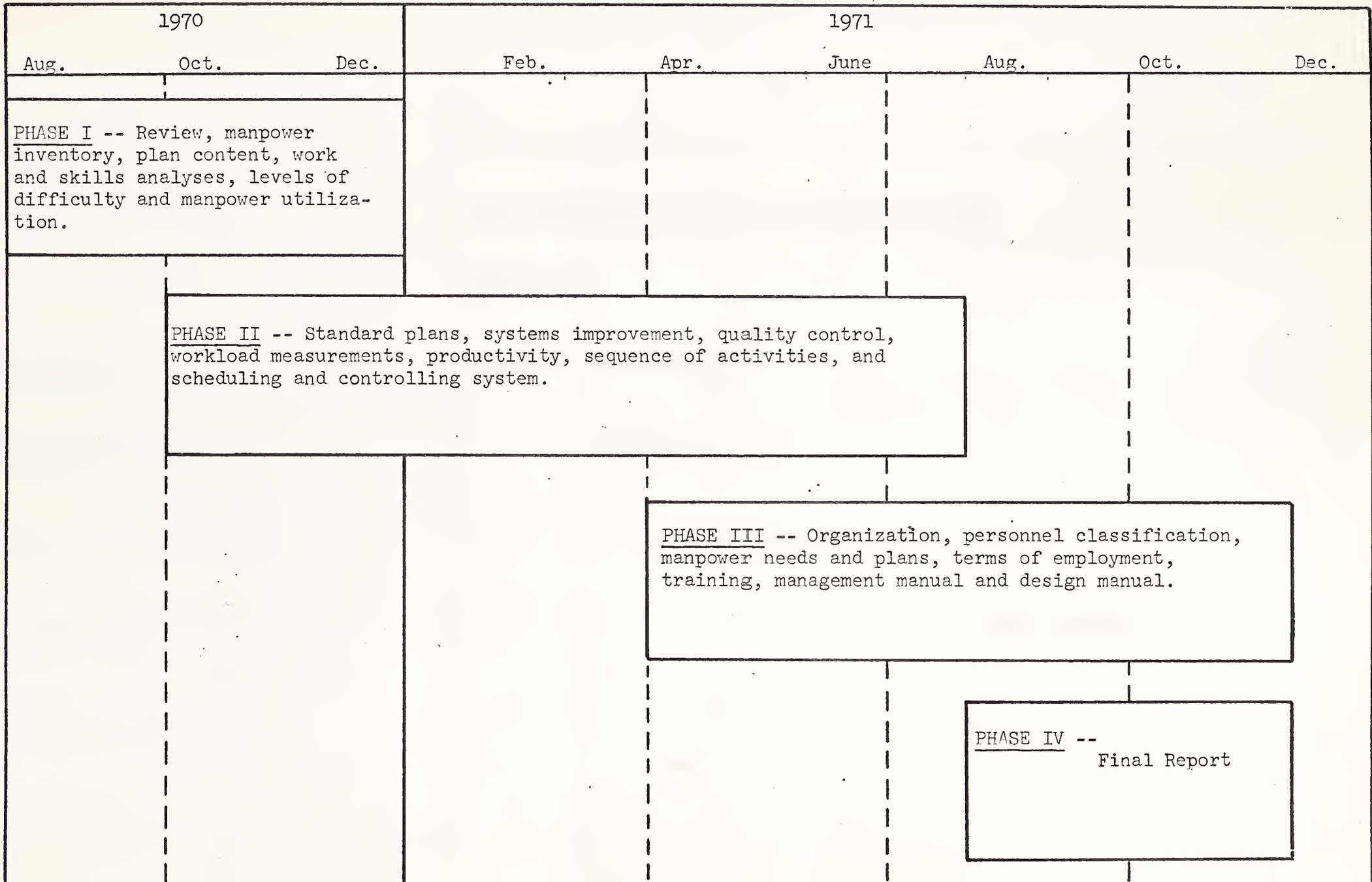
PROJECT SCHEDULES

Montana
State Hig y Commission

DESIGN MANAGEMENT RESEARCH PROJECT

SUMMARY SCHEDULE

August, 1970

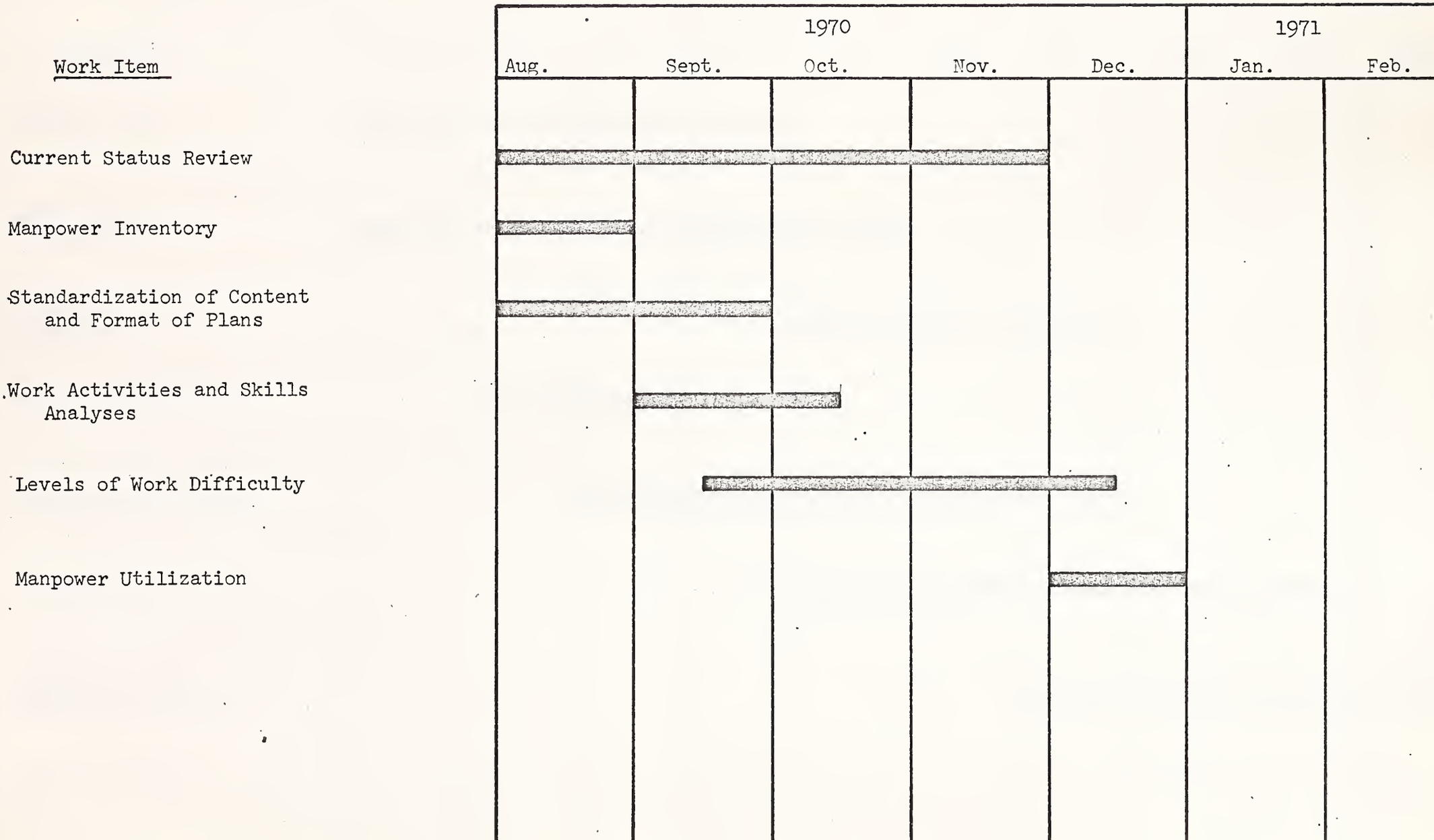

1970
Aug.
Oct.
Dec.
1971
Feb.
Apr.
June
Aug.
Oct.
Dec.
PHASE I -- Review, manpower inventory, plan content, work and skills analyses, levels of difficulty and manpower utilization.
PHASE II -- Standard plans, systems improvement, quality control, workload measurements, productivity, sequence of activities, and scheduling and controlling system.
PHASE III -- Organization, personnel classification, manpower needs and plans, terms of employment, training, management manual and design manual.
PHASE IV -- Final Report

Montana
State Highway Commission

DESIGN MANAGEMENT RESEARCH PROJECT

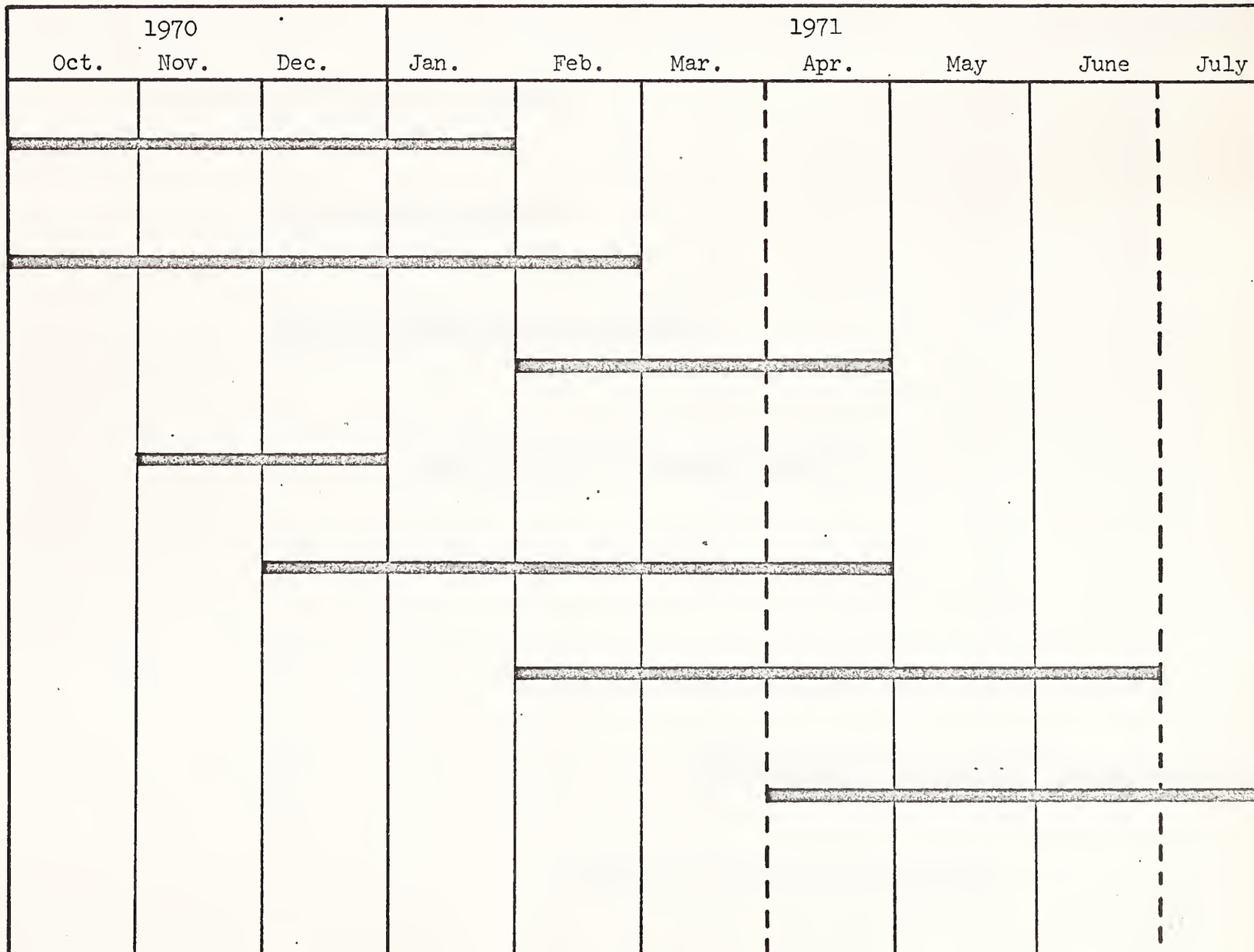
PHASE I
DETAIL SCHEDULE

August, 1970

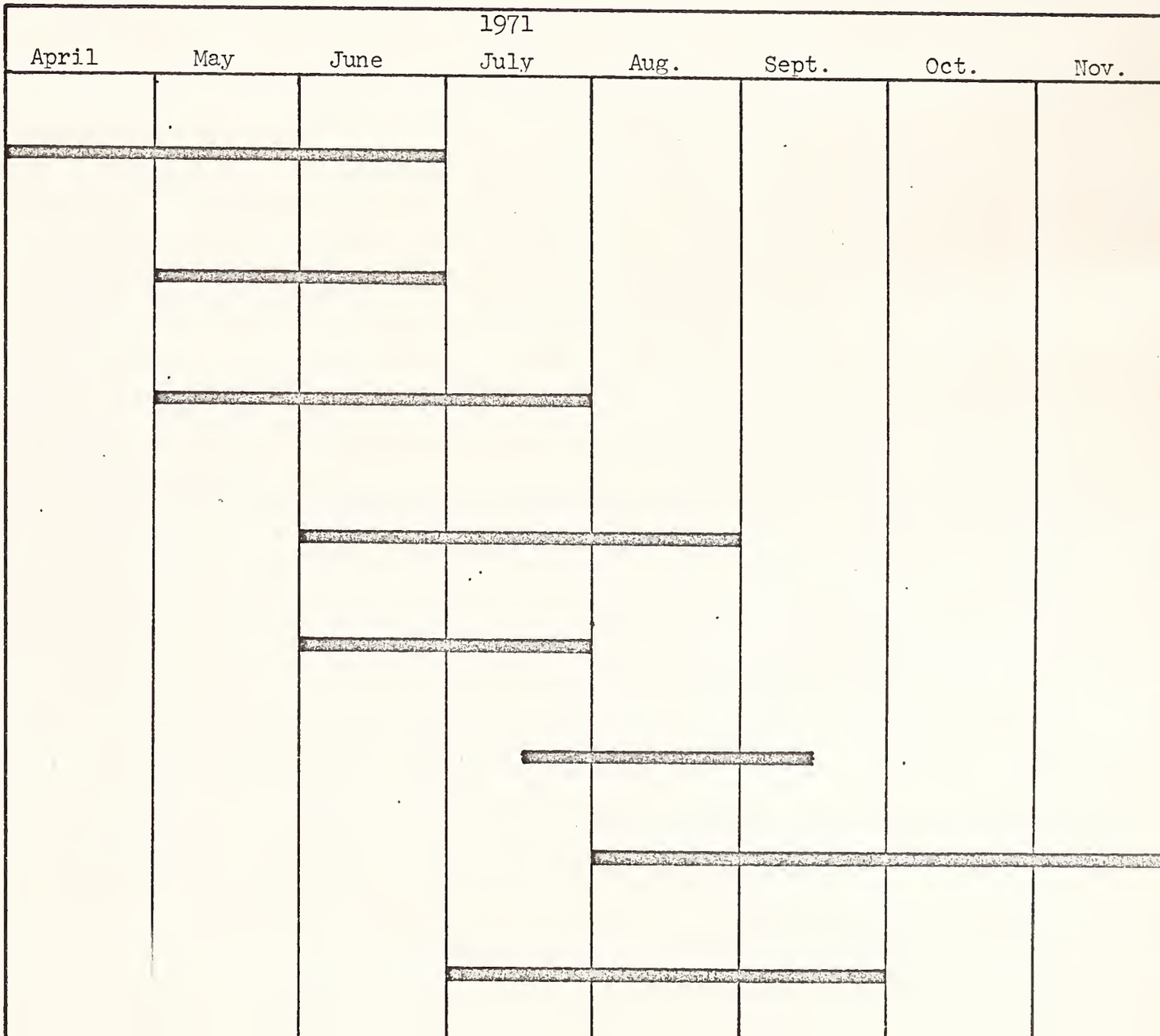


Montana
State Highway Commission

DESIGN MANAGEMENT RESEARCH PROJECT
PHASE II
DETAIL SCHEDULE
August, 1970



Montana
State Highway Commission

DESIGN MANAGEMENT RESEARCH PROJECT

PHASE III
DETAIL SCHEDULE
August, 1970